

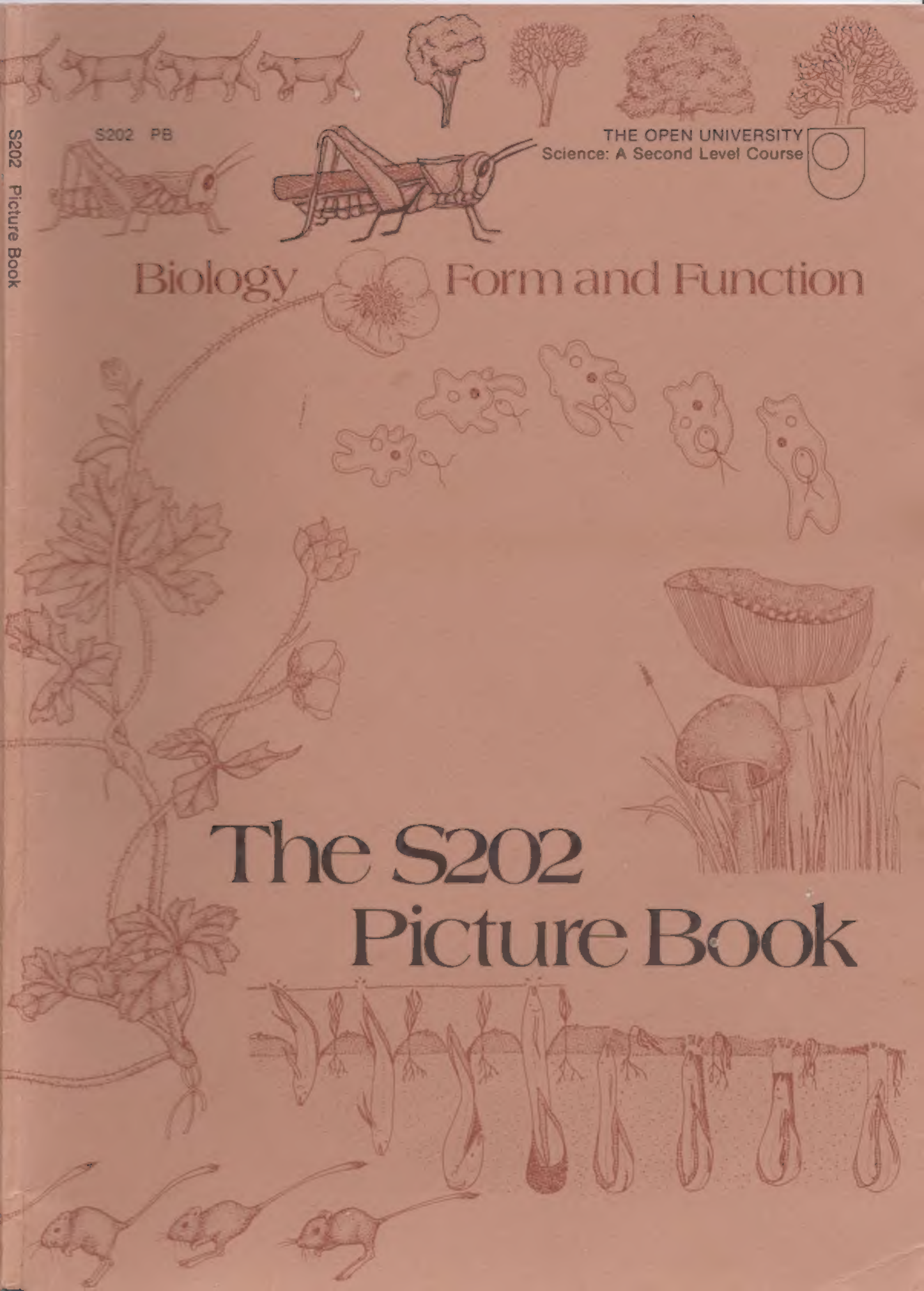
S202 PB

THE OPEN UNIVERSITY  
Science: A Second Level Course



# Biology Form and Function

## The S202 Picture Book







# The S202 Picture Book

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This text forms part of an Open University course. The complete list of Units in the Course is printed at the end of this text.

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# how to use this book

This book consists of colour pictures and electron micrographs that need to be reproduced by a specialist printer on heavy-grade paper if they are to be seen to best advantage.

The illustrations are grouped according to the subject blocks of the Course and are numbered consecutively. References to the illustrations are generally made in the margins of the Units. We expect you to act on each reference as you come to it, turning first to the relevant pages of this book using the contents list as your guide. If you do not immediately find the picture you need, turn to the index of plates at the back of this book for the 'key words' of the reference, and you will be directed to the plate number (in bold type) and page number of the picture you are seeking.

Note that Unit 4 is different in that it is built around illustrations in this book. It therefore has a different system of reference—see the Study guide to Unit 4.

The *Home Experiment Notes* refer to illustrations directly, by number.

You may of course leaf through *The S202 Picture Book* for general interest and you will also find it provides a helpful back-up to *A Survey of Living Organisms*\*.

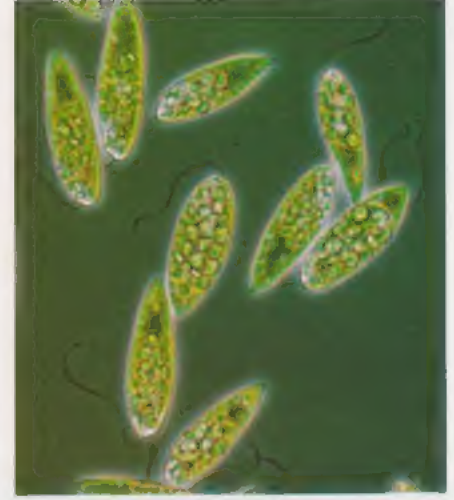
\*The Open University (1981) *SLO A Survey of Living Organisms*.



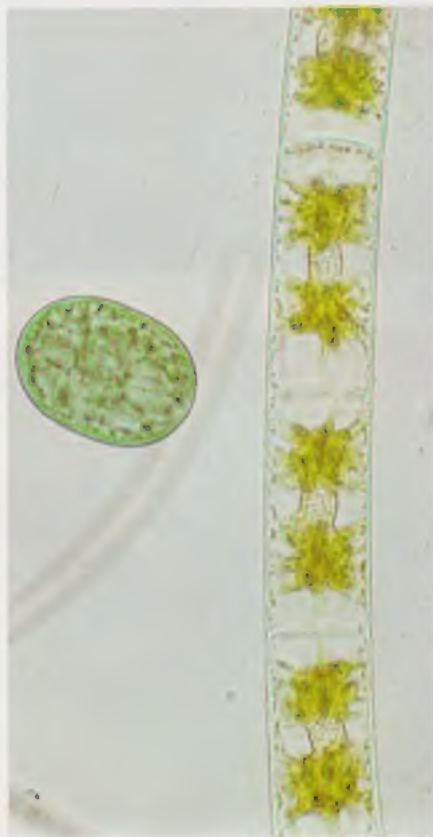
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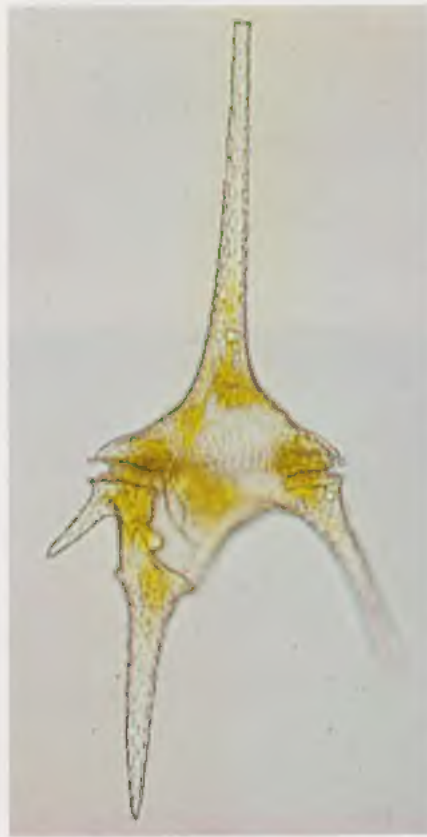
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4



5



6



7

**1** *Anabaena*, a filamentous blue-green alga, class Cyanophyceae, Kingdom Prokaryota. The larger cells (10 µm) in the middle of the filaments are heterocysts.

**2** *Navicula* (60 µm), a diatom, class Bacillariophyceae, division Chrysophyta. The individuals look different because they are viewed from different angles. Markings on the siliceous valves are just visible.

**3** *Euglena* (50 µm), division Euglenophyta. Each organism has a long flagellum and many chloroplasts.

**4** A solitary blue-green alga (50 µm), class Cyanophyceae, and *Zygnema*, a filamentous green alga, class Chlorophyceae. In *Zygnema*, note the two star-shaped chloroplasts in each cell and the vacuoles; neither of these features is visible in blue-green cells.

**5** *Ceratium* (300 µm), a dinoflagellate, division Pyrrophyta, class Dinophyceae. The groove round the middle carries one flagellum and the firm outline is due to the presence of cellulose plates that form three spines.

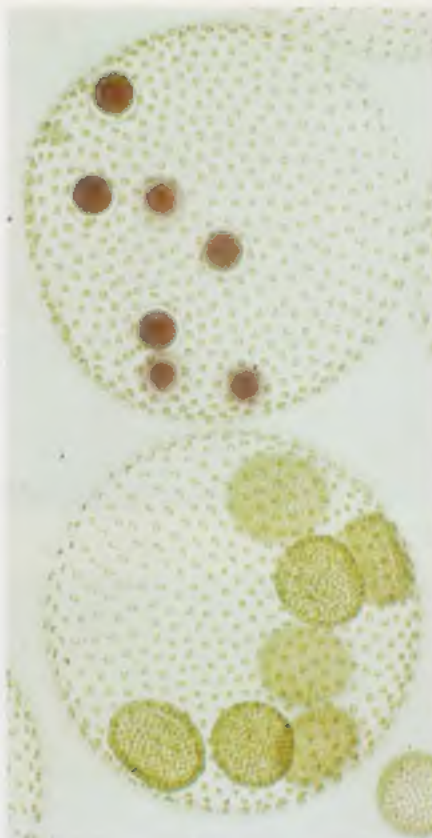
**6** *Chlamydomonas* (20 µm), a unicellular, flagellated green alga, class Chlorophyceae. There is a pair of flagella of equal length and a single chloroplast.

**7** *Amoeba* (0.5 mm), phylum Protista, class Sarcodina. Note the single nucleus and spherical contractile vacuole and short pseudopodia.



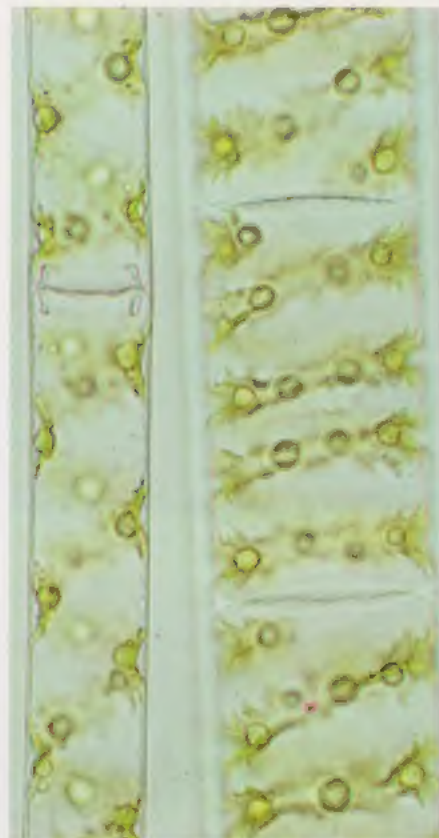
8

**8** *Vorticella* (60  $\mu\text{m}$ ), phylum Protista, class Ciliata. Each has conspicuous cilia (forming a spiral) that beat food particles into the gullet, a meganucleus, a micronucleus, a contractile vacuole and stalks with a central contractile filament.



9

**9** *Volvox* (1 mm), a colonial green alga, class Chlorophyceae. Each individual resembles a single *Chlamydomonas*. There are daughter colonies inside the main colonies.



10

**10** *Spirogyra* (40  $\mu\text{m}$  and 100  $\mu\text{m}$  diameter), a filamentous green alga, class Chlorophyceae. The spirally arranged chloroplasts are typical.



11

**11** *Paramecium* (250  $\mu\text{m}$ ), phylum Protista, class Ciliata. Note the cilia, the gullet, food vacuoles, the meganucleus and two contractile vacuoles (one with collecting channels).



12

**12** *Micrasterias* (300  $\mu\text{m}$ ), a desmid, class Chlorophyceae. This unicellular green alga has a pair of cellulose cases forming two 'semi-cells'. It looks similar to a diatom, but the pigments are different and the cases are of different materials.

**13** Flowers of *Rubus* (blackberry) with a butterfly (*Lycaena phloea*, order Lepidoptera) sipping nectar. The plant is an angiosperm (family Rosaceae) with open flowers and many stamens.



13

**14** *Tortula muralis*, a moss, superclass Bryophyta. The sporophytes are tall with slender capsules at their tips from which spores are released. The gametophyte forms a cushion on rocks and walls.



14



15



16



17



18



19



20

19

**15** A branch of a larch tree *Larix*, subclass Gymnospermidae. The cones are old female cones which have opened, showing seeds.

**16** *Polytrichum*, a moss, superclass Bryophyta (seen from above). Note the shoot tips of the gametophytes with male reproductive organs.

**17** A branch of birch *Betula*, subclass Angiospermidae. This is wind-pollinated and the flowers form catkins of two sexes. Male flowers form the catkin that hangs down and the small female catkin is upright.

**18** *Lamium album* (white deadnettle). The flowers are complex in shape with stamens arched under the upper petal; when bees alight on the lower lip they are brushed with pollen.

**19** *Marchantia*, a liverwort, superclass Bryophyta. The small cups on the upper surface are gemmae, in which small vegetative propagules develop. The umbrella-like structures carry male reproductive organs.

**20** *Equisetum*, a horsetail, class Sphenopsida. The central thick shoot bears reproductive structures (sporangia). The leaves are arranged in whorls at the nodes.

**21** *Lycopodium clavatum*, a club moss, class Lycopsiada. These leafy shoots arise from a rhizome and carry sporangia in the axils of the leaves near the tips.



21



22



23

22 *Ganoderma applanata* (bracket fungus). This is the fruiting body of a basidiomycete that grows in dead and dying trees.

23 Flowers of the honeysuckle *Lonicera periclymenum*; these are pollinated by insects. They are of complex shape with nectaries at the base of a long tube.

24 *Peziza coccineus* (a cup fungus). This is the fruiting body of an ascomycete.

25 Knapweed (*Centaurea*) visited by a bumble bee *Bombus hortorum*. This 'flower' is a collection of similar florets, each with stamens and stigmas. The bee belongs to the order Hymenoptera and is already dusted with pollen.

26 *Morchella vulgaris* (a morel). This is an edible fruiting body of an ascomycete.

27 Flowers of *Heracleum* (hogweed) with a visiting beetle (*Strangalia quadrifasciata*, order Coleoptera). This plant belongs to the order Umbelliferae and has characteristic flower heads.

28 *Armillaria mellea* (honey fungus). These are fruiting bodies of a basidiomycete fungus that lives on rotting wood.

29 *Amanita muscaria* (fly agaric). This is the fruiting body of a basidiomycete fungus and it is very poisonous.

30 *Phallus impudicus* (stink horn), the fruiting body of a basidiomycete. The spores are dispersed by flies that are attracted by the smell.

31 A tipulid (daddy-long-legs), order Diptera. Note the haltere behind the left wing.



24



25



26



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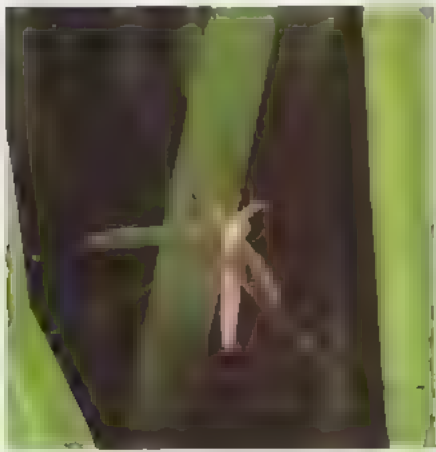
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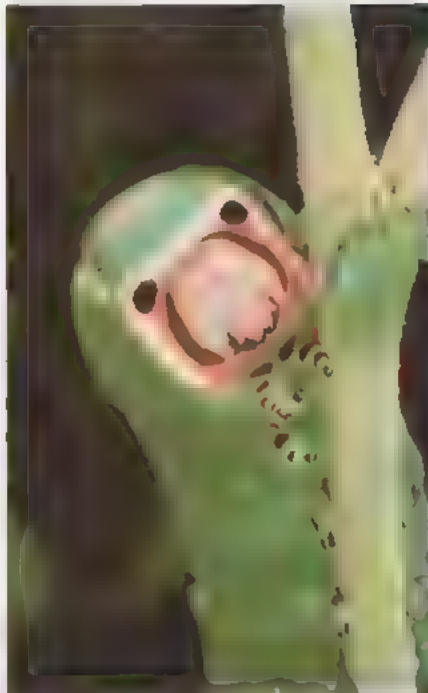
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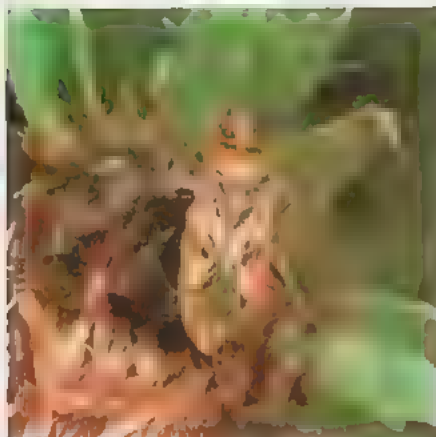
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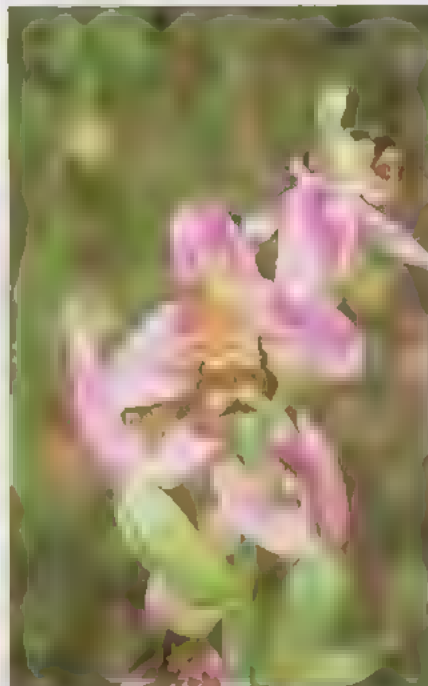
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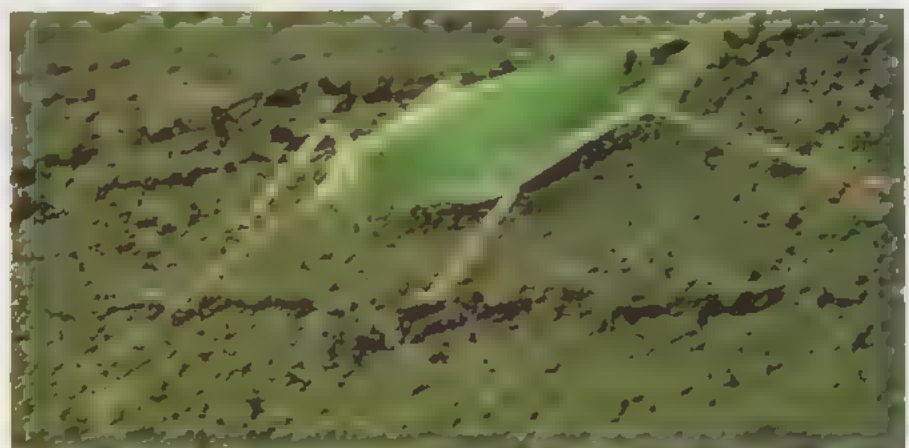
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37



38

**32** Puss moth caterpillar (*Cercora vinula*, order Lepidoptera). There are three pairs of short thoracic legs and paired abdominal 'pro-legs'

**33** Burnet moths (*Zygaena filipendula*, order Lepidoptera) copulating. The female emerged from the pupal case (right). This poisonous moth flies by day.

**34** *Coriza hyoscyami*, a bug (order Hemiptera). Note the forewings.

**35** *Peripatus*, a primitive uniramian from Australia. The soft body looks velvety because of the many tracheal openings

**36** *Ophrys apifera*, a bee orchid, mimicking a female bee; male bees try to copulate with the flowers

**37** A black carabid beetle (order Coleoptera) with a small worker ant (order Hymenoptera).

**38** *Meconema*, a bush cricket (order Orthoptera). Note the membrane forewings.





42



43

42 *Chaetodon* (butterfly fish), a teleost that lives among coral reefs, seen in front of a coral colony, with tentacles expanded.

43 *Triturus vulgaris*, the smooth newt, class Amphibia.

44 Life on a sandy shore. A picture showing typical animals of British sandy shores and of the sea above



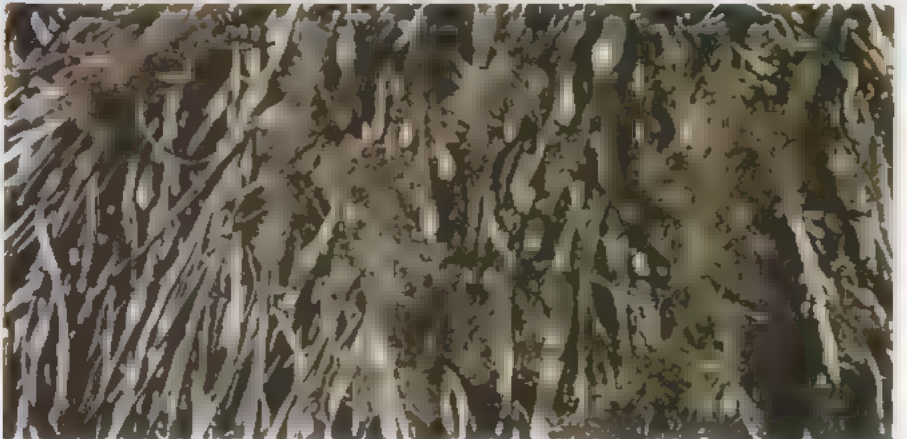
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48



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51

**45** *Laminaria* (tangle, oar-weed), a brown seaweed that grows on the lower shore and in shallow seas. There is a narrow stipe and a broad, flat lamina.

**46** *Fucus serratus* (serrated wrack), a brown seaweed that lives on the lower part of the middle shore. It lacks bladders.

**47** *Ascophyllum nodosum* (knotted wrack), a brown seaweed, with *Polysiphonia* (a red seaweed) growing on it. Both live on the middle shore. Note the large air-bladders and narrow thallus of the wrack.

**48** *Fucus vesiculosus* (bladder wrack), a brown seaweed that lives on the middle shore. Note the pairs of air-bladders and the flat thallus.

**49** Smooth periwinkles *Littorina littoralis* on fronds of *Fucus vesiculosus*. This mollusc species has many colour forms including bright yellow.

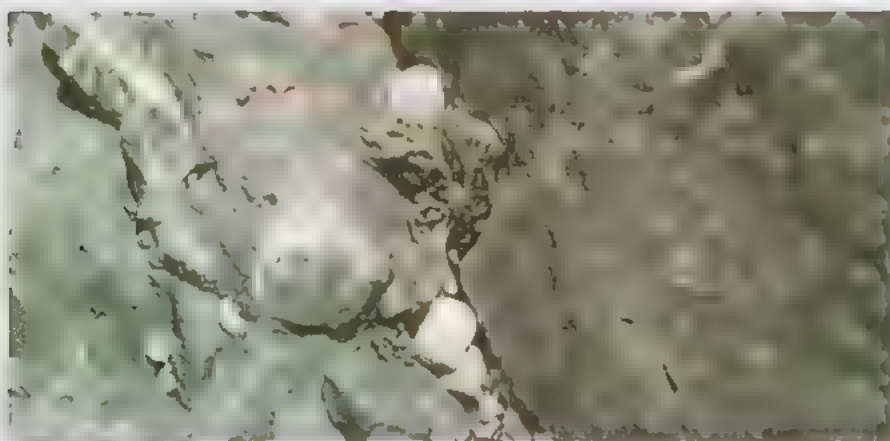
**50** *Pelvetia canaliculata* (channelled wrack), a brown seaweed that lives on the upper shore. The channels are on the underside of the thallus; the swollen tips contain reproductive organs

**51** Barnacles (*Chthamalus stellatus*) are crustaceans with calcareous shell plates attached to rocks.

**52** Rough periwinkles *Littorina saxatilis* (phylum Mollusca, class Gastropoda) retreat to crevices when the tide goes out.

**53** Common limpets *Patella vulgata* (phylum Mollusca, class Gastropoda).

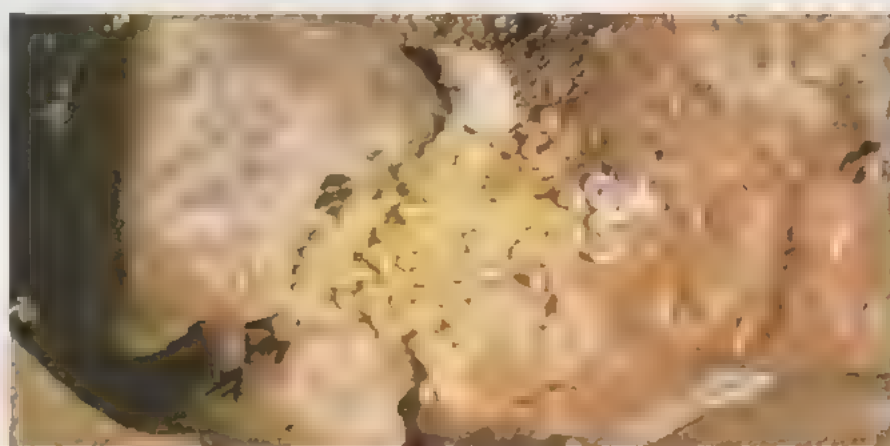
**54** Dog whelk *Nucella lapillus* with its egg cases attached to the rocks beside it. This carnivorous gastropod lives on the middle shore



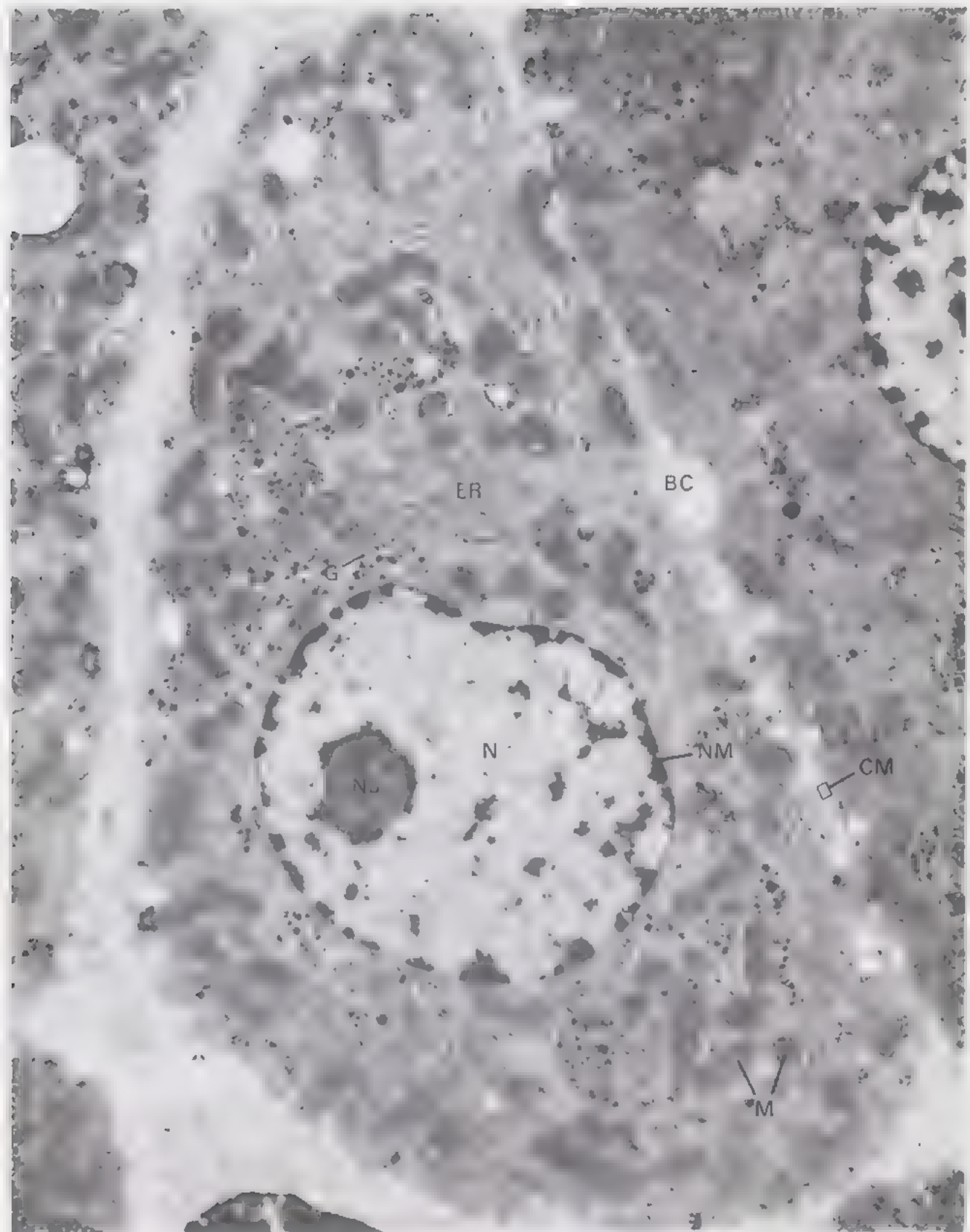
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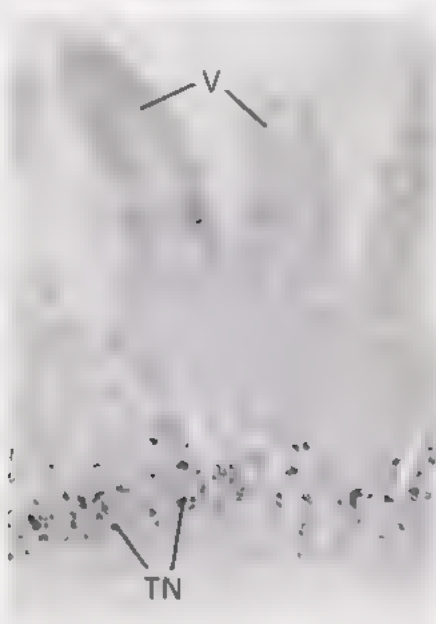


55A

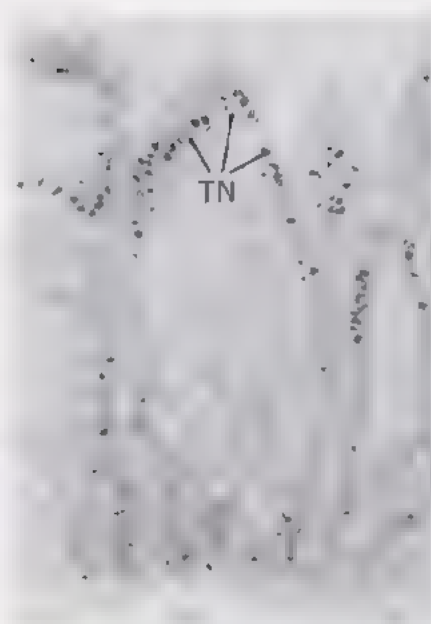
**55A** Electron micrograph of a whole rat liver cell showing nucleus (N), nucleolus (Nu), nuclear membrane (NM), mitochondria (M), endoplasmic reticulum (ER) (ribosomes are present on the endoplasmic reticulum but are barely visible at this low magnification), cell membranes (CM), bile canaliculus (BC) (part of the bile duct system) and glycogen granules (G). The Golgi apparatus is not visible in the section. ( $\times 9\,500$ )

**56B** Light micrographs of sections of the intestines of mice injected with thymidine: (a) 8 hours after injection; (b) 36 hours after injection. TN, tagged nuclei; V, villus. ( $\times 70$ )

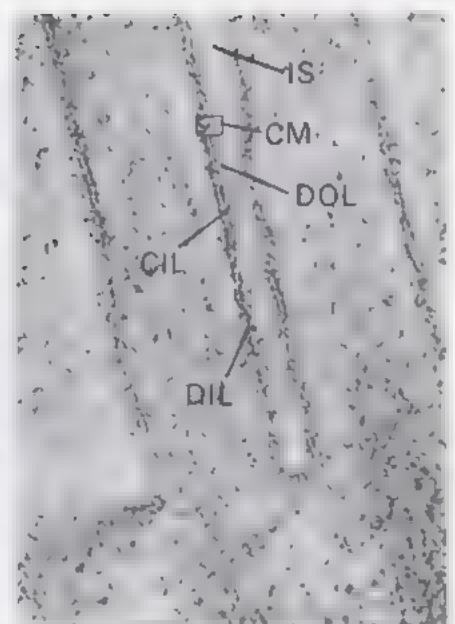
**57C** Electron micrograph of cell membranes (CM) of intestinal cells showing the three-layered membrane. DOL, dense outer layer; CIL, clear inner layer, DIL, dense inner layer; IS, intercellular space. ( $\times 160\,000$ )



56Ba



56Bb



57C



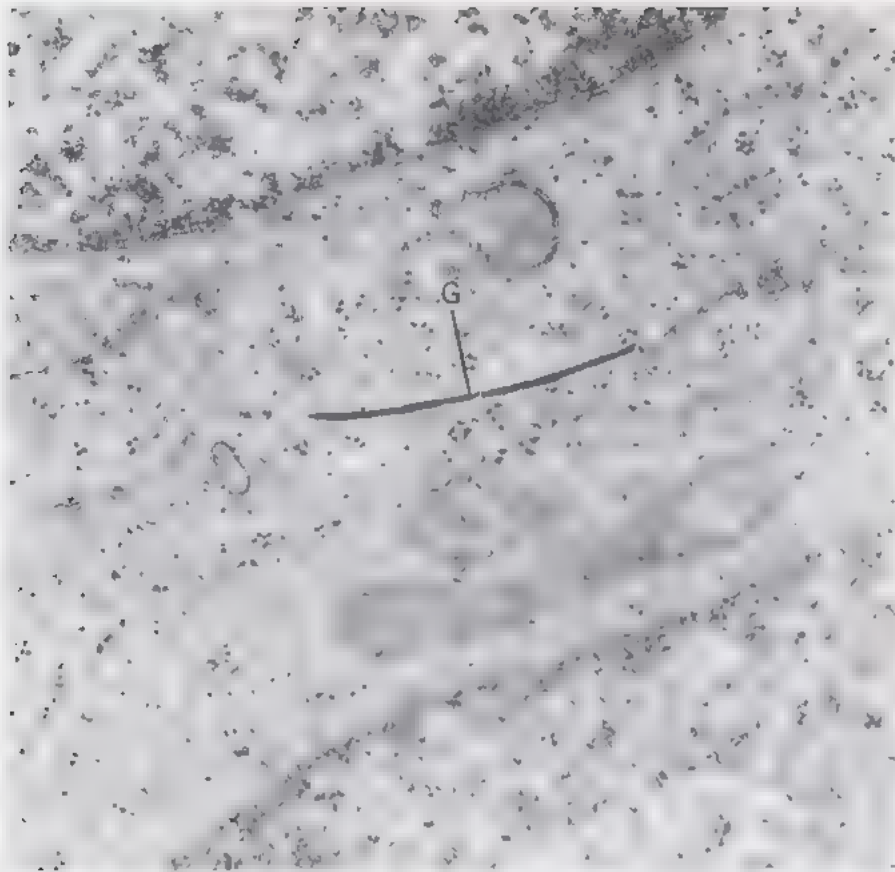
58D

**58D** Electron micrograph of freeze-etched cell membranes (CM) from two neighbouring cells in the pancreas. The inner face of the membrane (arrowed) contains many intramembraneous particles. ( $\times 250\,000$ )

**59E** Electron micrograph of the junctional complex between adjacent lateral cell membranes (LCM) of rat intestinal cells. In the region of the tight junction (TJ) the apposed membranes often appear fused though there is a small gap here. IJ, intermediate junction; D, desmosome, ACM, apical cell membrane; Mv, microvillus ( $\times 105\,000$ )

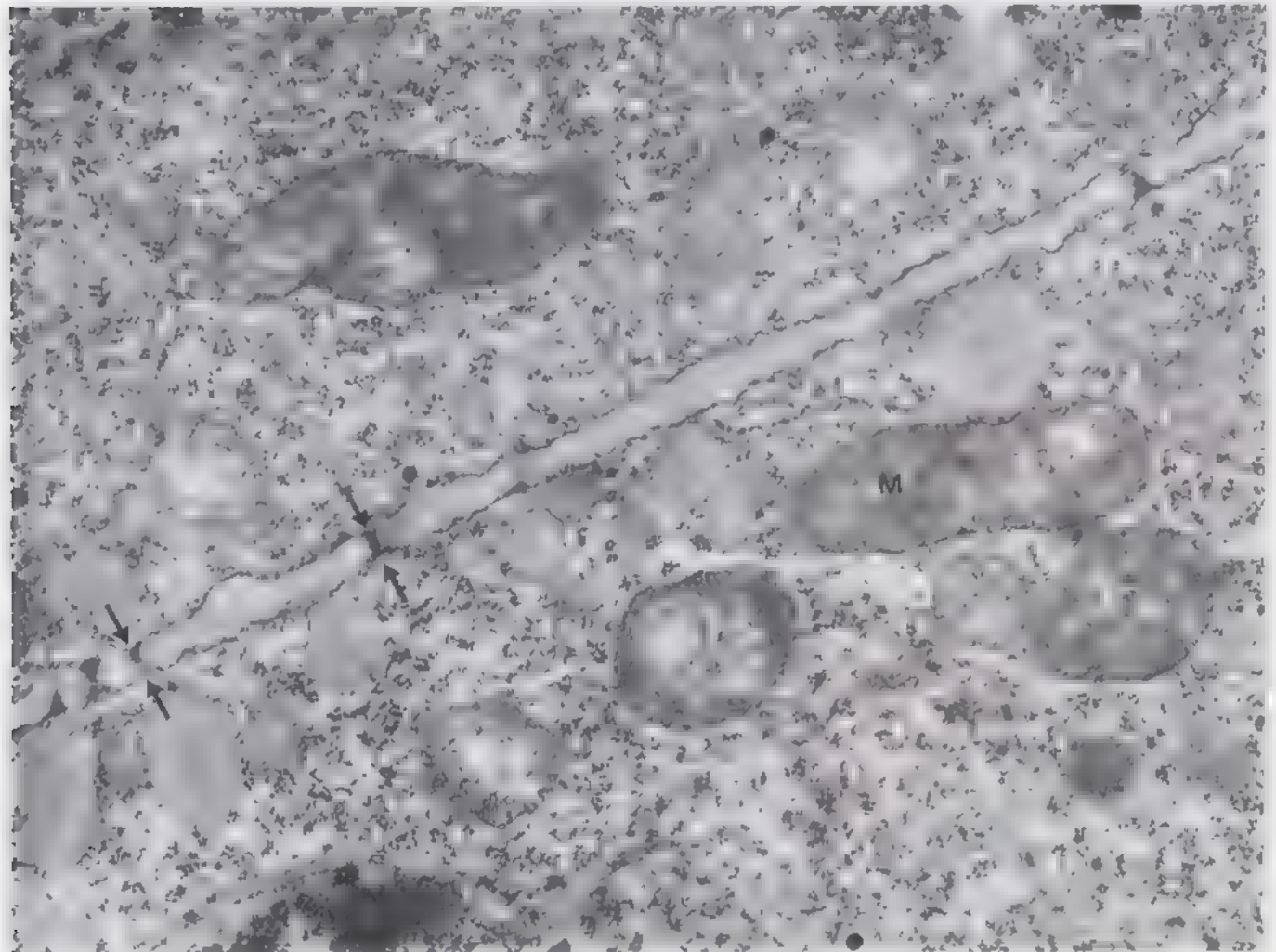


59E

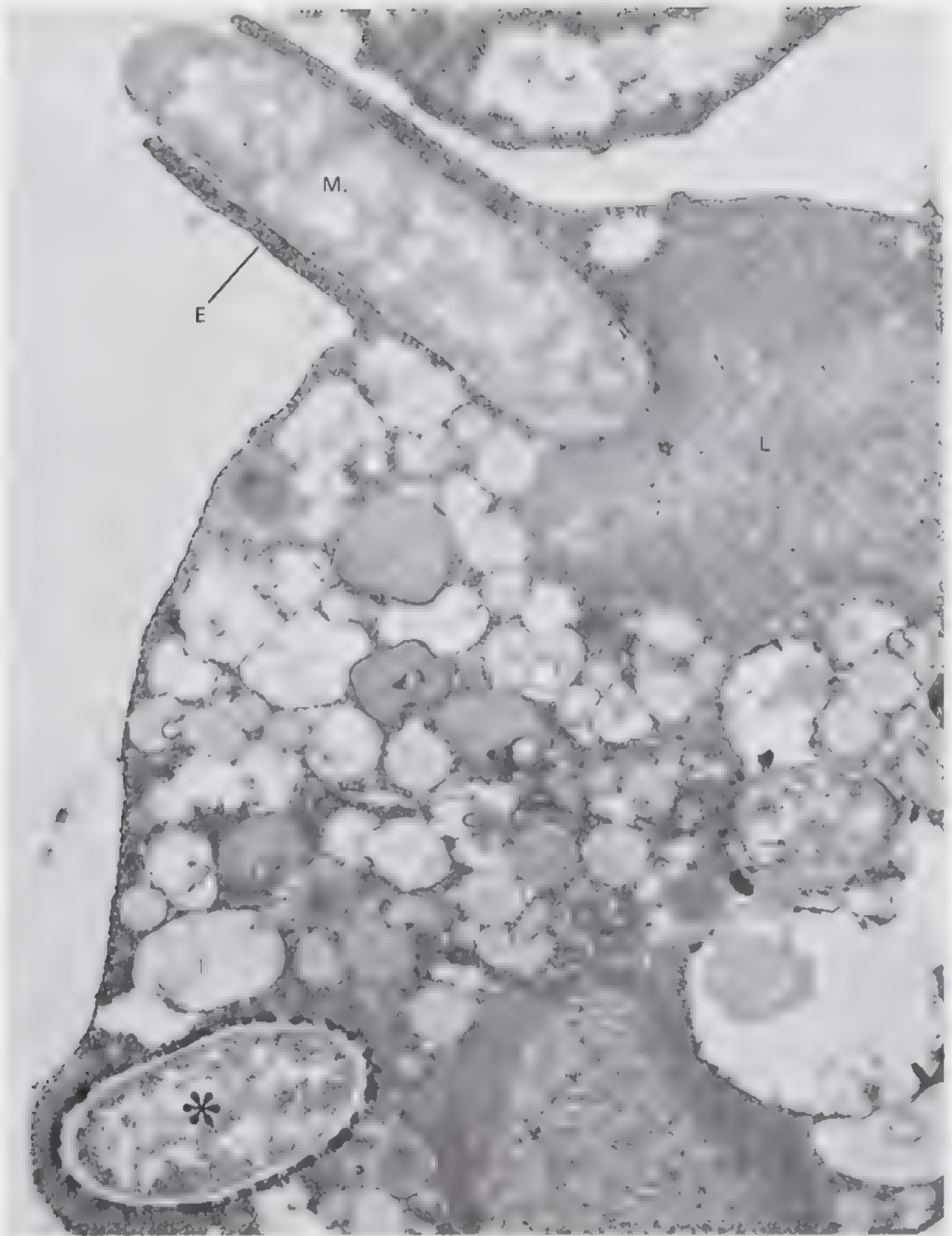


**60F** Electron micrograph of a gap junction (G) in an ovarian granulosa cell. ( $\times 30\,000$ )

**61G** Electron micrograph of the boundary between adjacent corn (*Zea*) cells showing plasmodesmata (arrowed) and mitochondria (M). ( $\times 18\,000$ )

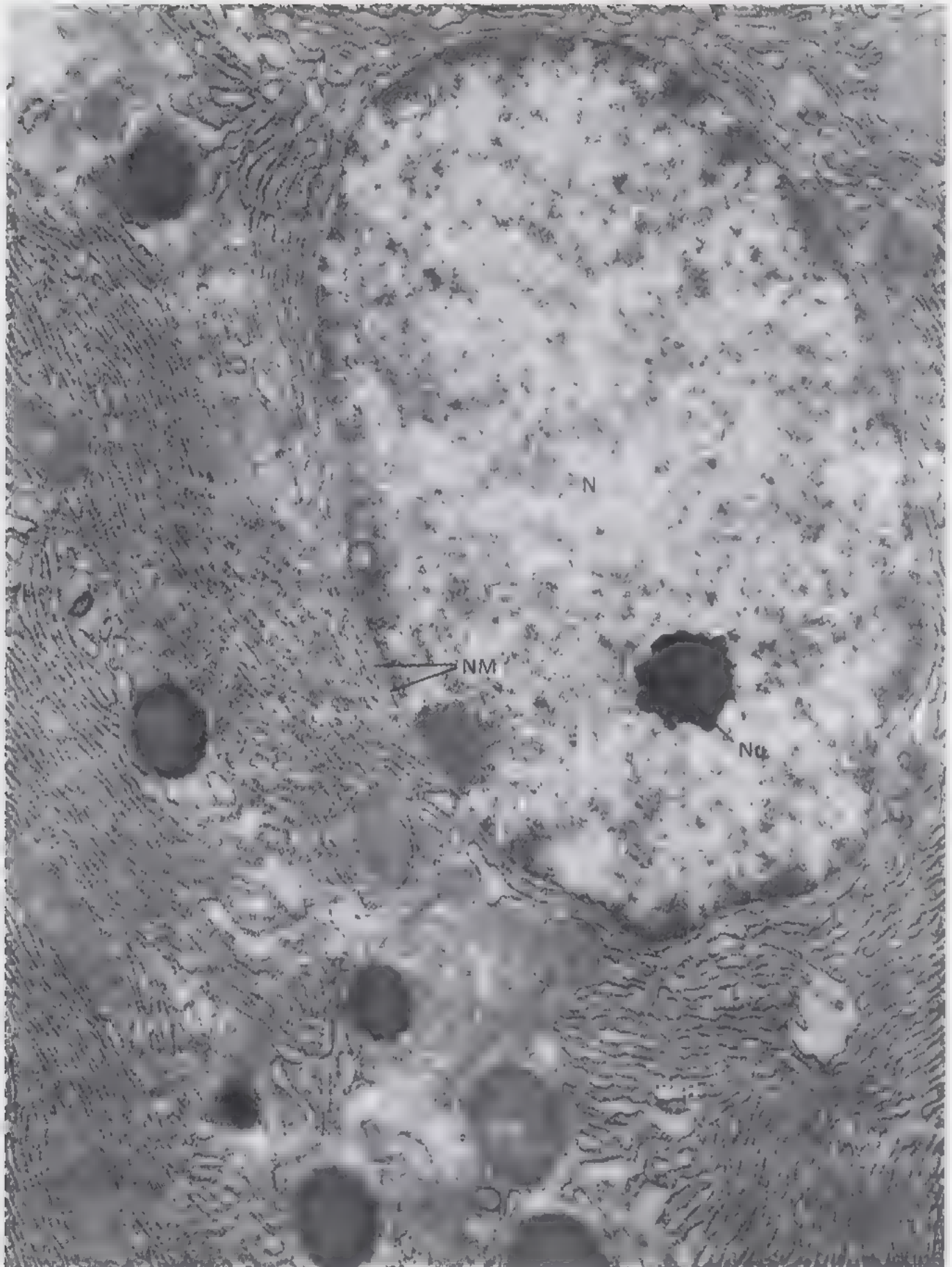


**61G**



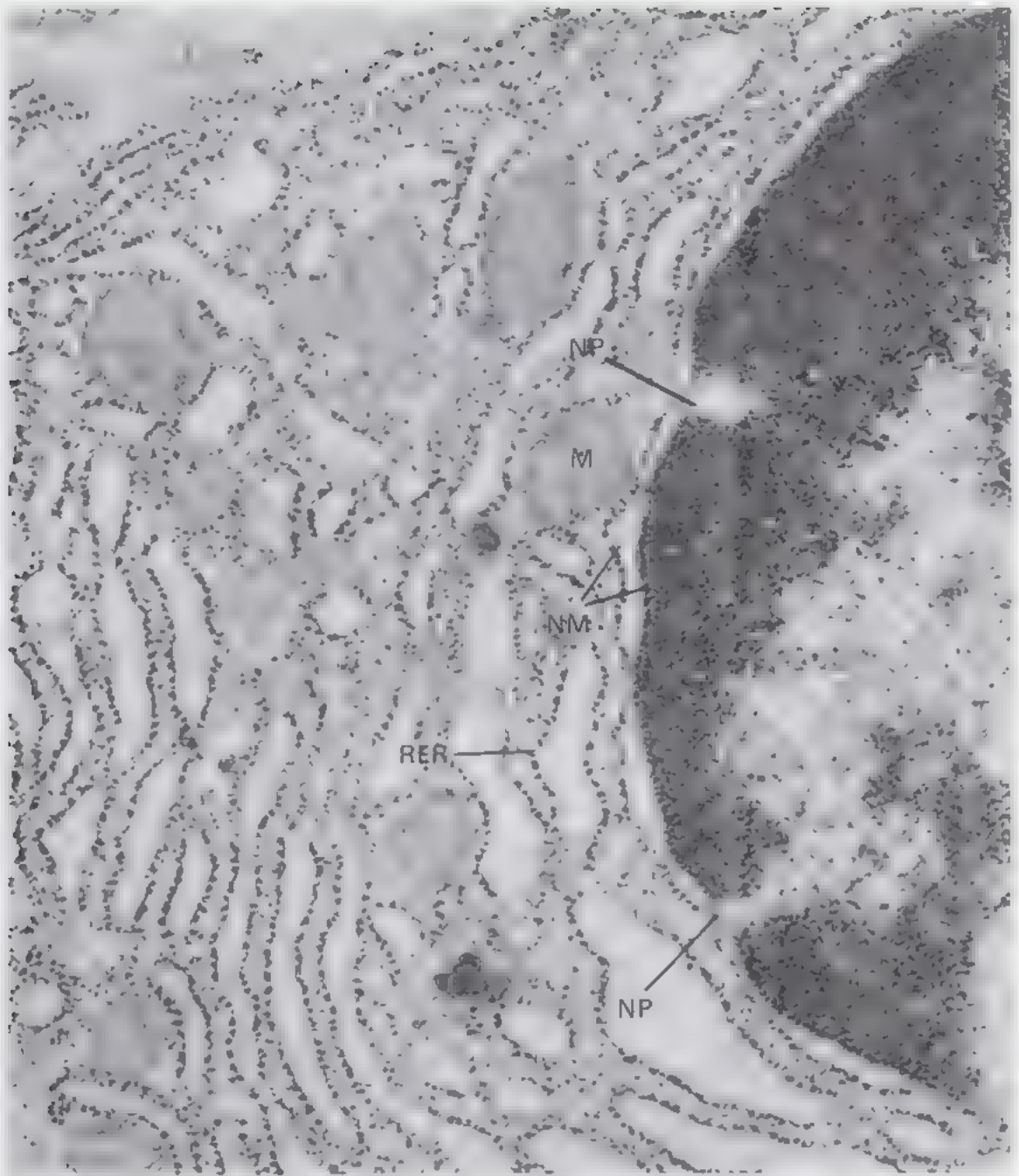
62H

**62H** Electron micrograph showing phagocytosis by a polymorphonuclear leucocyte (L). Note the evagination (E) around a micro-organism (M) and another micro-organism enclosed within the cell (\*). ( $\times 40\,000$ )



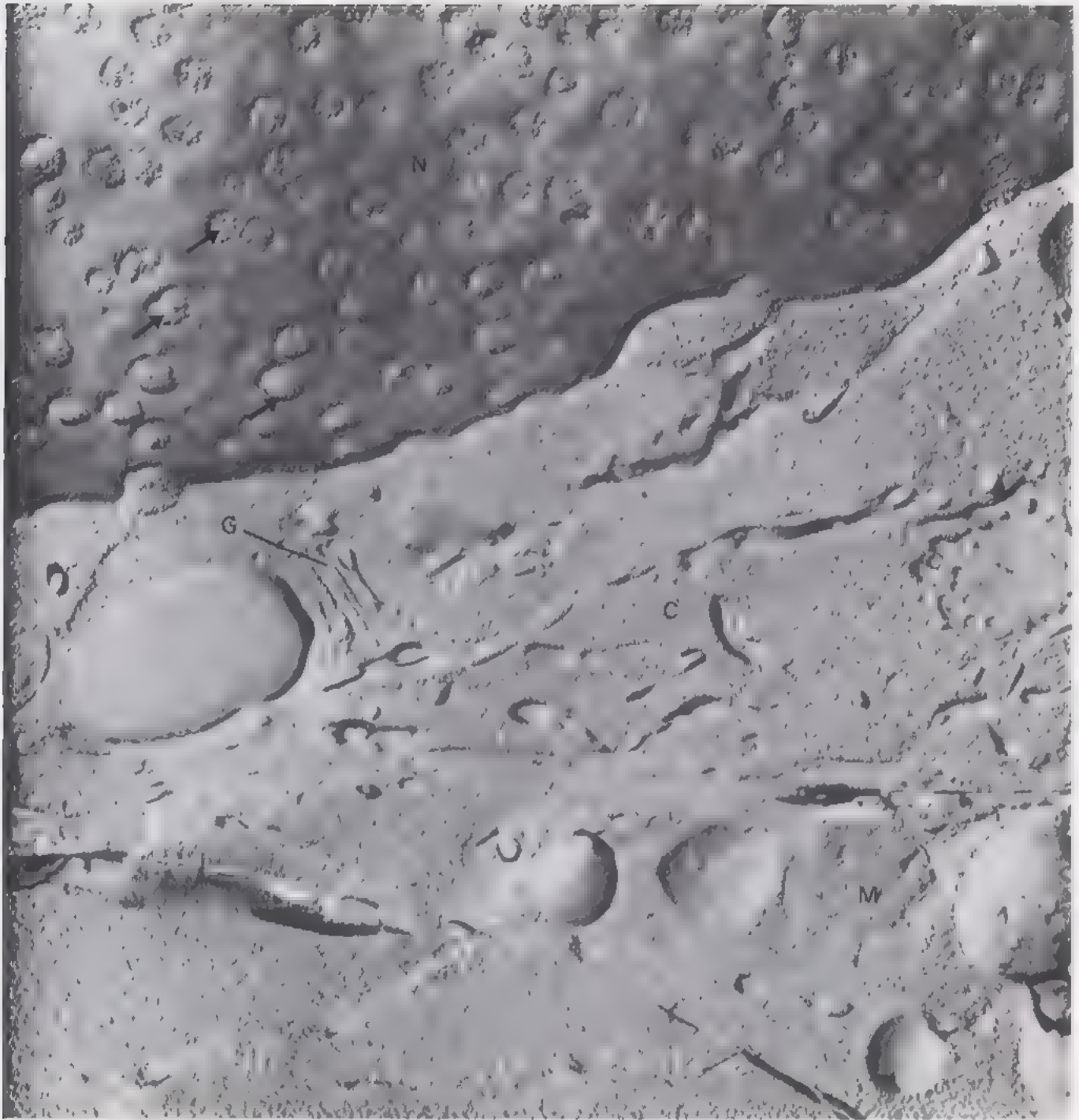
631

631 Electron micrograph of a liver cell showing nucleus (N), nucleolus (Nu), nuclear membranes (NM), nuclear pore (NP), rough endoplasmic reticulum with ribosomes (RER), G, Golgi apparatus; M, mitochondria; DB, dense bodies. ( $\times 27\,500$ )



64J

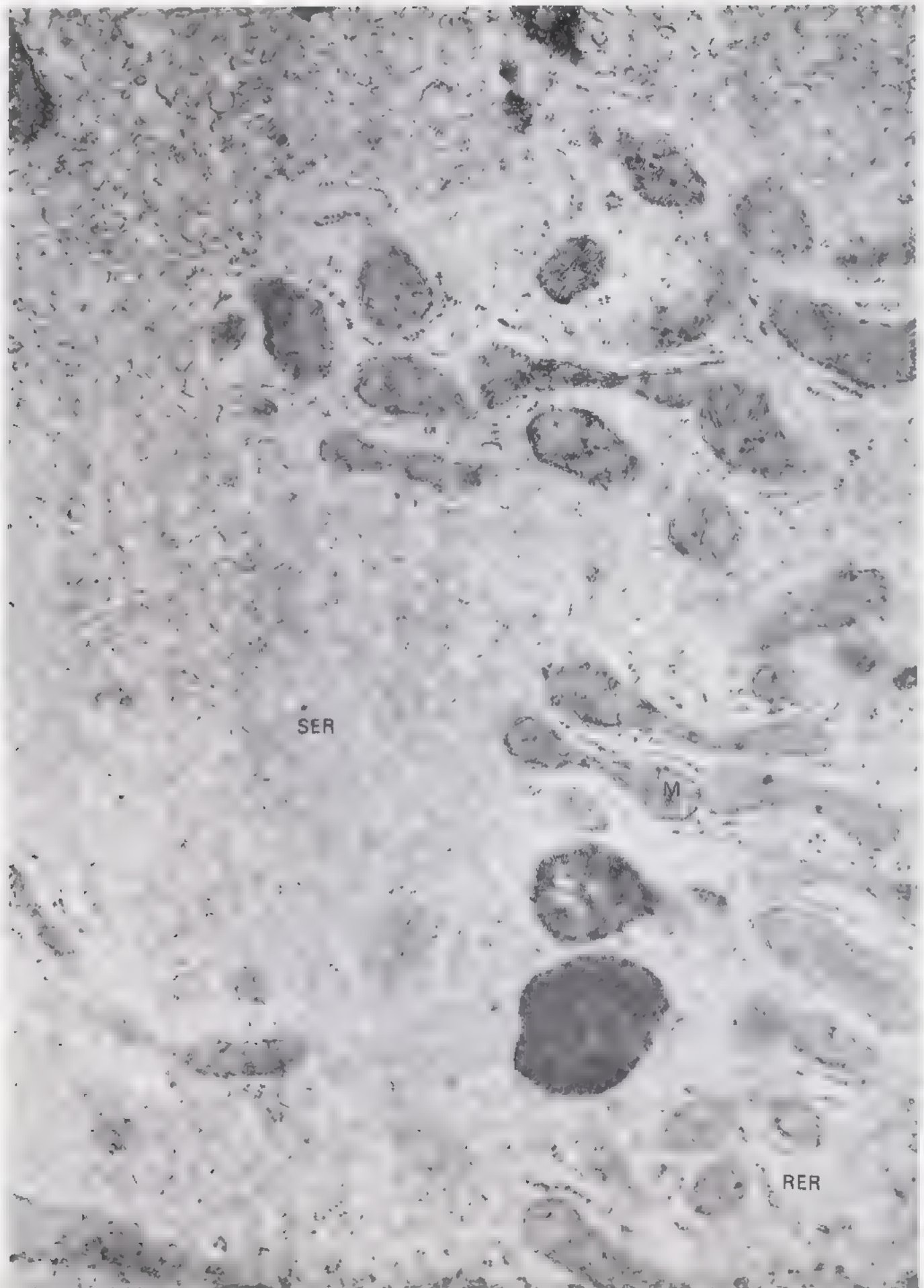
64J Electron micrograph of a liver cell showing nuclear membranes (NM) with ribosomes on the cytoplasmic side, nuclear pores (NP), extensive rough endoplasmic reticulum (RER) and mitochondria (M). (× 45 000)



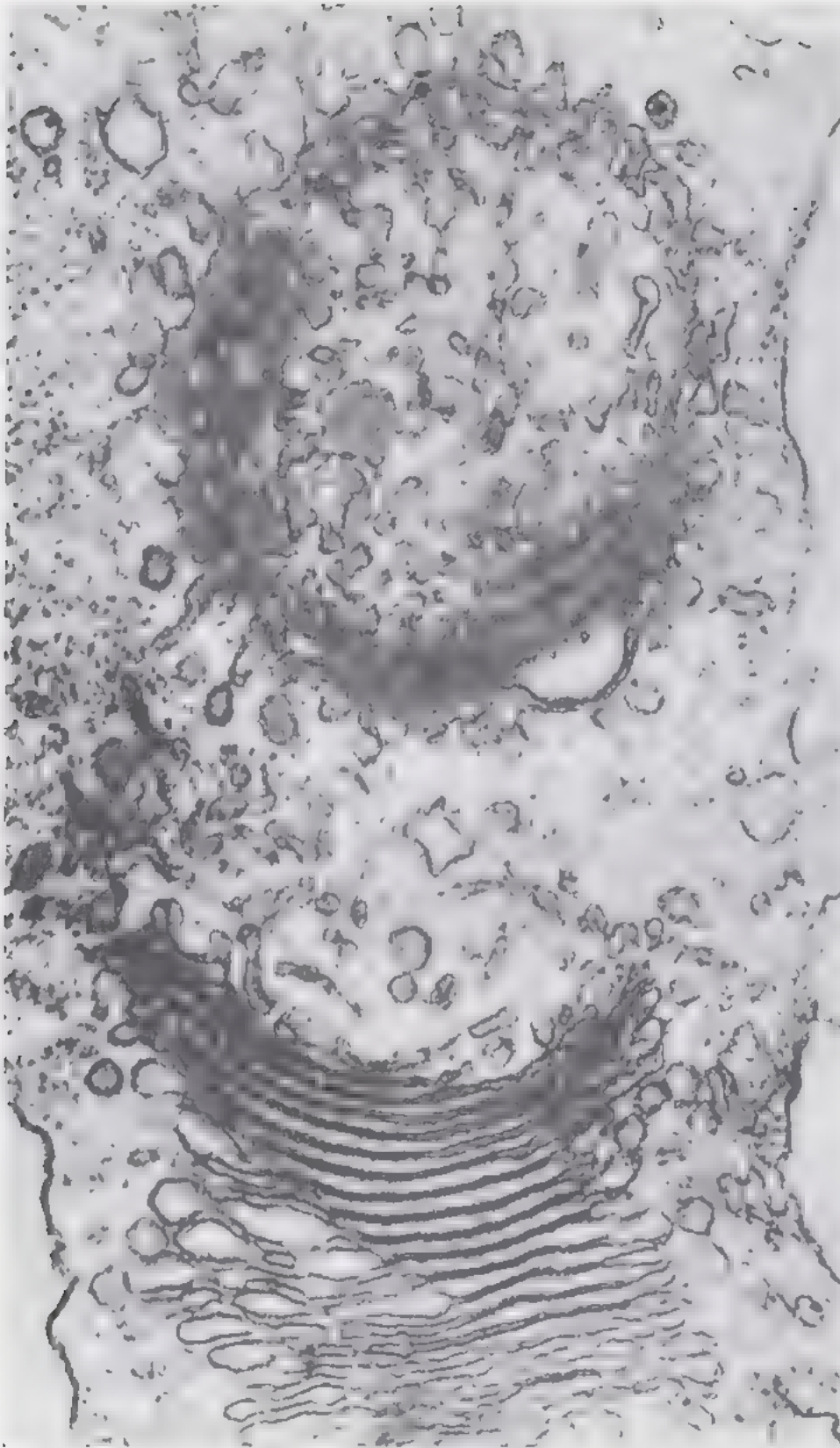
65K

**65K** Electron micrograph of a freeze-etched preparation from an onion. Note the pores (arrowed) seen in both transverse and cross-section. N, nucleus; C, cytoplasm; G, Golgi apparatus; M, mitochondria. ( $\times 25\,000$ )

**661** Electron micrograph of a cell from the human liver. The left-hand side of the field is packed with the twisted cisternae of the smooth endoplasmic reticulum (SER). At the bottom right is some rough endoplasmic reticulum (RER); also on the right are mitochondria (M). ( $\times 32\,000$ )

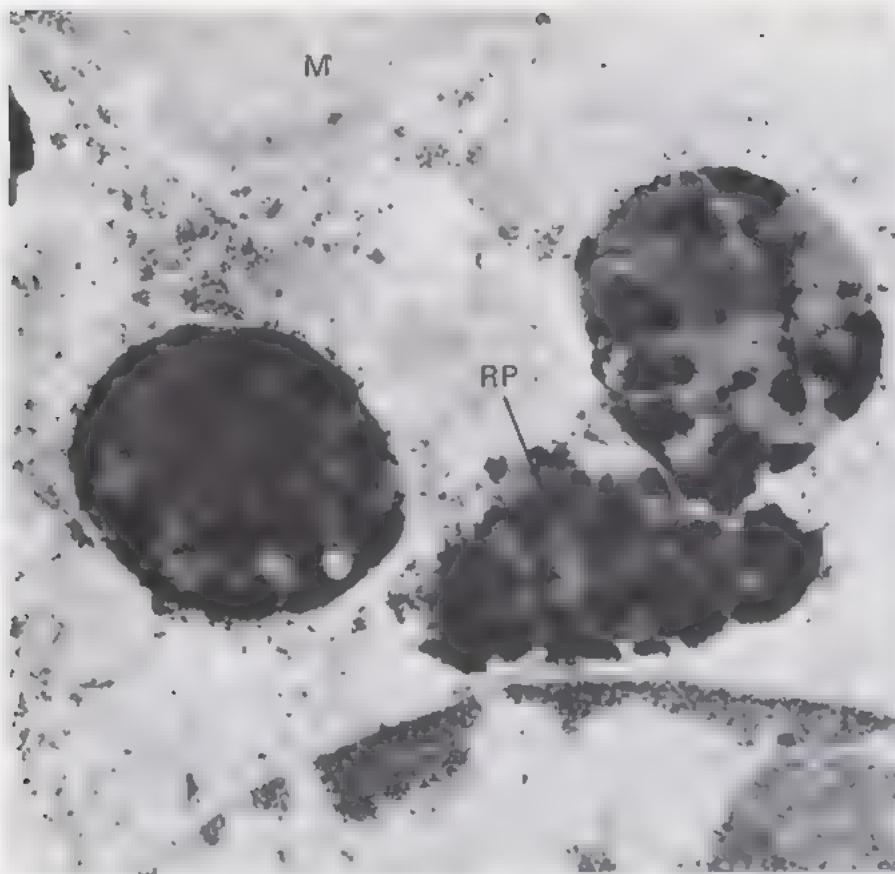


66L

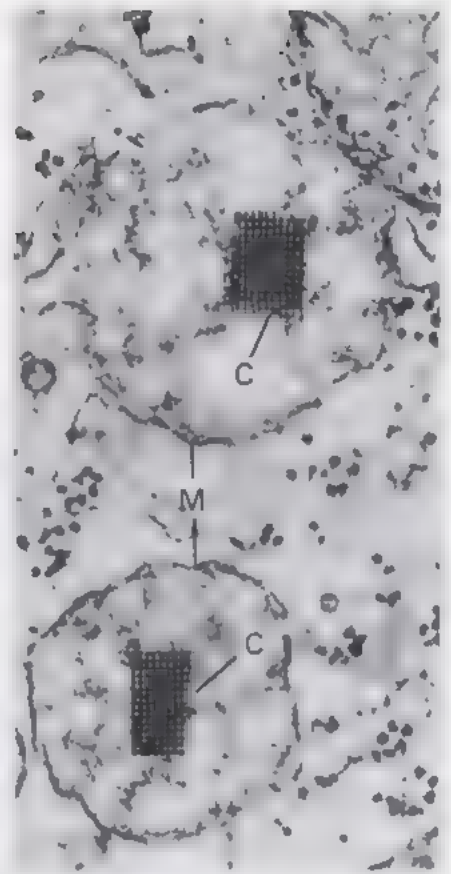


67M

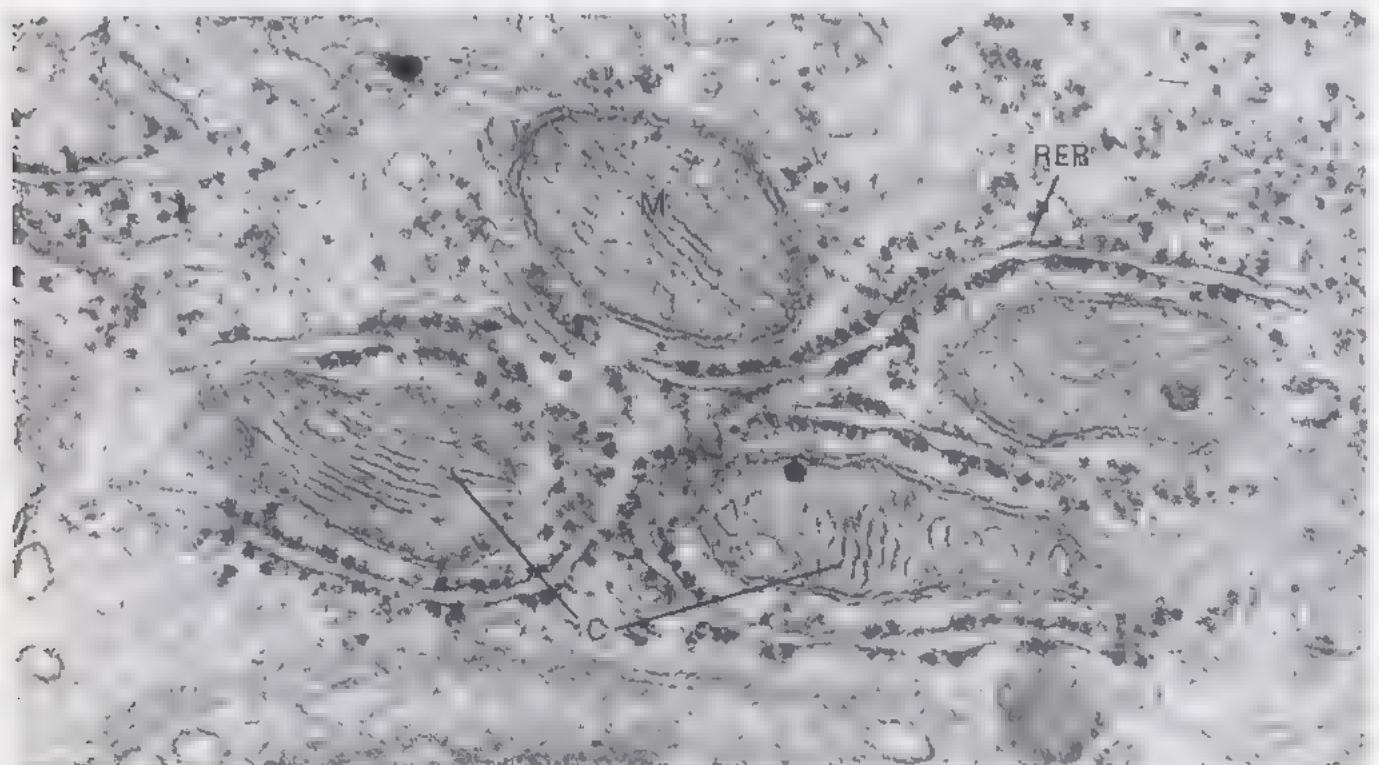
67M Electron micrograph of the Golgi apparatus. ( $\times 47\,000$ )



68N



69O

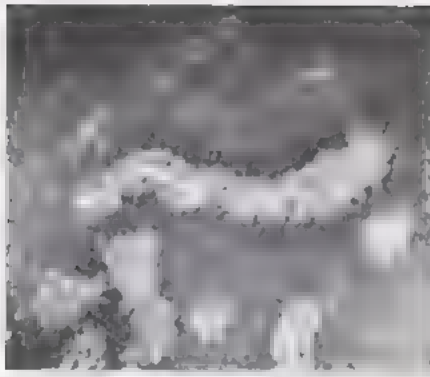


70P

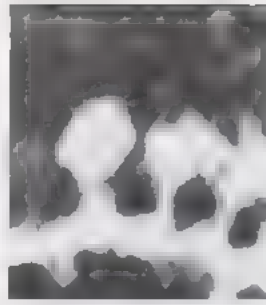
**68N** Electron micrograph of a liver cell showing dense bodies believed to be lysosomes (L), reaction product (RP) indicating the site of acid phosphatase activity and a mitochondrion (M). ( $\times 25\,000$ )

**69O** Electron micrograph of two peroxisomes from a cell of the grass plant *Avena* showing the single external membrane (M) and the core of densely staining, crystal-like material (C). ( $\times 108\,000$ )

**70P** Electron micrograph showing mitochondria (M) from a liver cell with transverse or longitudinal cristae (C). Note the rough endoplasmic reticulum (RER) surrounding the mitochondria. ( $\times 88\,000$ )



71Qa

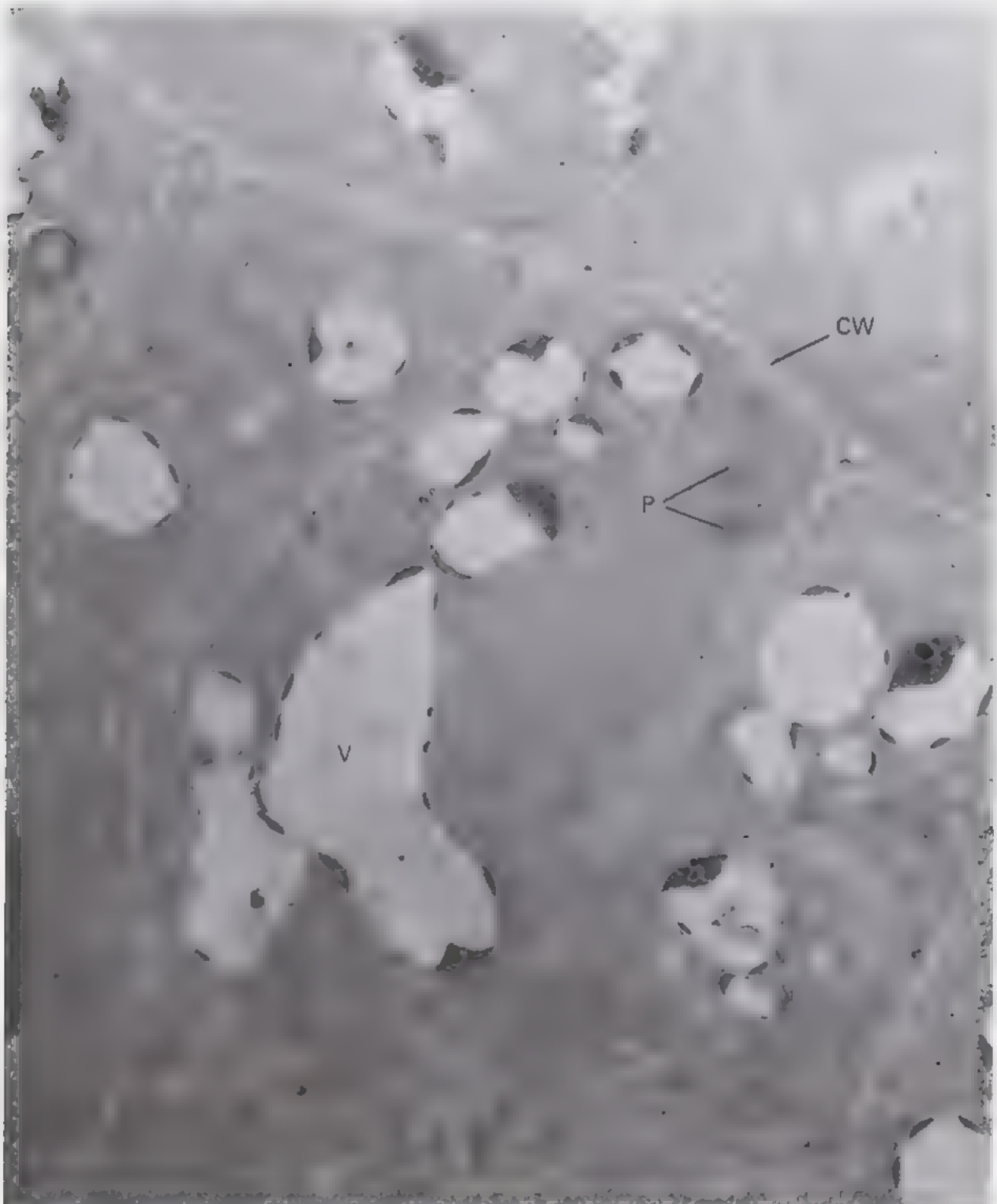


71Qb

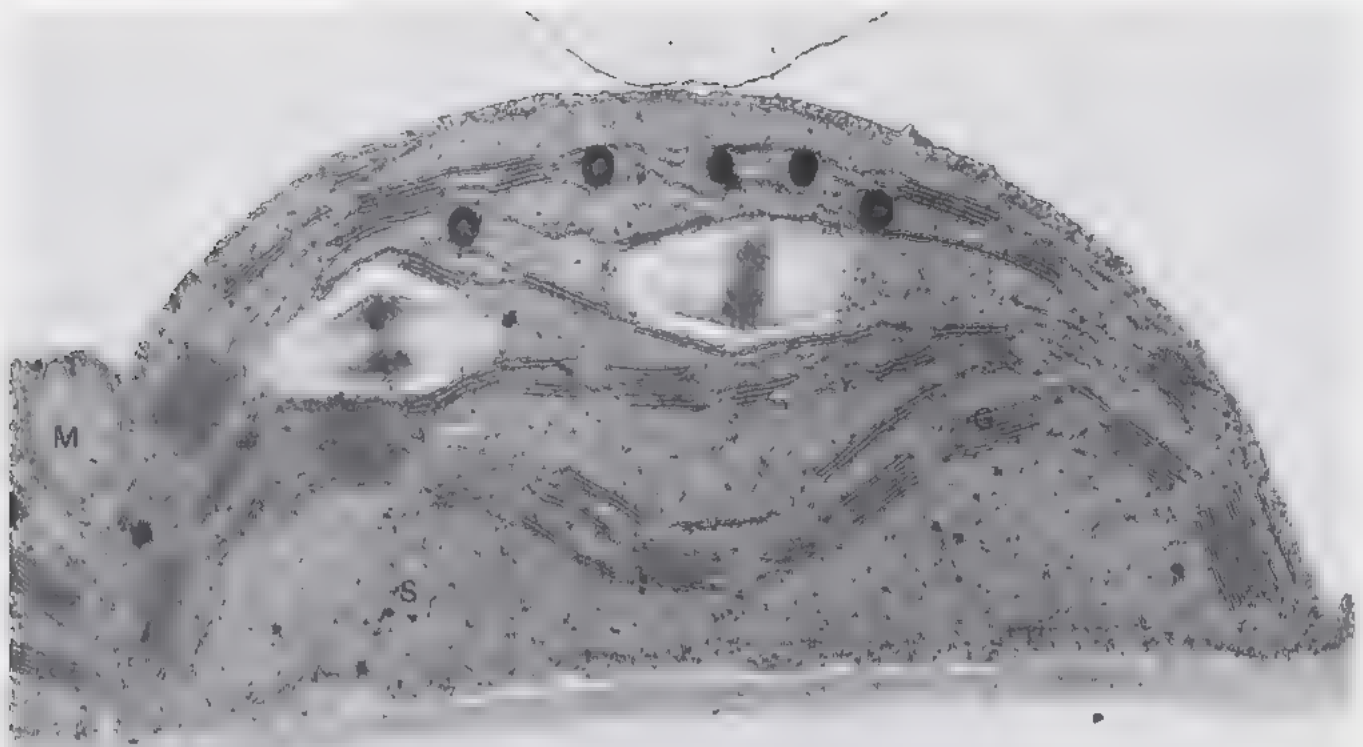
**71Q** (a) Electron micrograph of isolated cristae from a mitochondrion swollen in a hypotonic solution and negatively stained with phosphotungstate. ( $\times 150\,000$ )

(b) An enlargement showing the elementary ( $F_1$ ) particles (*arrowed*). ( $\times 650\,000$ )

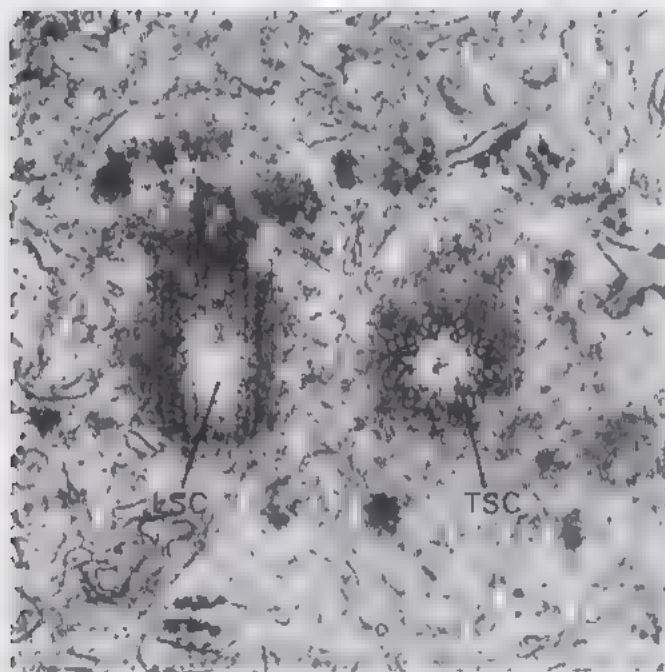
**72R** Electron micrograph of an immature plant cell showing proplastids (P). Note also the cell wall (CW) and vacuole (V). ( $\times 2\,000$ )



72R



73S

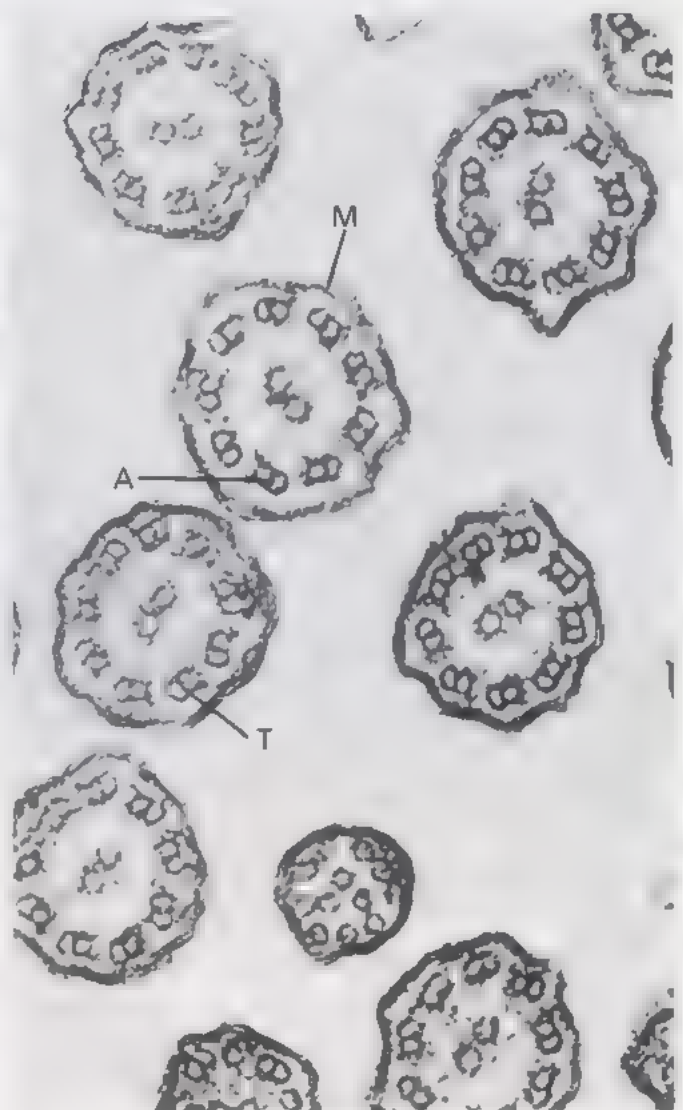


74T

**73S** Electron micrograph of a chloroplast showing stacks of grana (G) within the stroma (S). A mitochondrion (M) is on the left. ( $\times 25\,000$ )

**74T** Electron micrograph of a pair of centrioles in a Chinese hamster cell, at right angles to each other. TSC, transversely sectioned centriole showing nine triplets of subunits skewed towards the centre. LSC, longitudinally sectioned centriole. ( $\times 37\,000$ )

**75U** Electron micrograph of cilia in transverse section showing the '9 + 2' arrangement of tubules (T). Note the short 'arms' on the A tubules of each doublet, and the membrane (M) surrounding the cilia. ( $\times 180\,000$ )



75U



76V

76V Electron micrograph of mitochondria in a rat liver cell fixed with potassium permanganate ( $\times 86\,000$ )



77W

77W Electron micrograph of mitochondria in a rat liver cell fixed conventionally with glutaraldehyde followed by osmium tetroxide. ( $\times 86\,000$ )

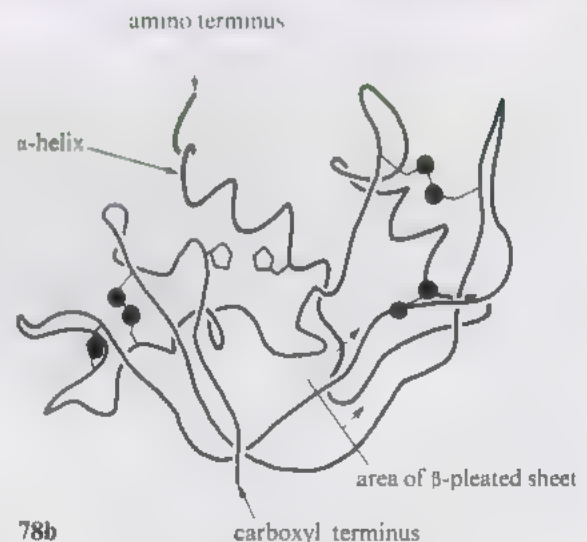


78a

**78** (a) A model showing the three-dimensional structure of ribonuclease. The polypeptide chain is shown as white with hydrogen bonds as red bars; negatively charged, amino acid side chains are shown as blue spheres, positively charged side chains as red spheres and sulphur atoms concerned in disulphide bonding as prominent yellow spheres. Tyrosine, tryptophan and other hydrophobic amino acids are shown as purple spheres

Note that the overall shape of the molecule is a V, with the active site cleft between the two arms of the V (this cleft runs vertically from the top of the molecule). You should also be able to see that the structure is held together by hydrogen bonds in both of the common secondary structures, the  $\beta$ -pleated sheet and  $\alpha$ -helix. The most obvious region of an  $\alpha$ -helix is close to the N-terminus (amino terminus; see (b)) and forms one face of the cleft. This helix runs from top left to bottom right, and you should be able to see the hydrogen bonds parallel to the direction of the helix. The bottom right-hand edge of the molecule contains a large area of  $\beta$ -pleated sheet, consisting of three chains held together by hydrogen bonds perpendicular to the direction of the chain.

(b) The folding of the polypeptide backbone in ribonuclease. The orientation of the molecule is the same as in (a). Disulphide bridges are shown as solid black circles and active site histidines as aromatic ring structures

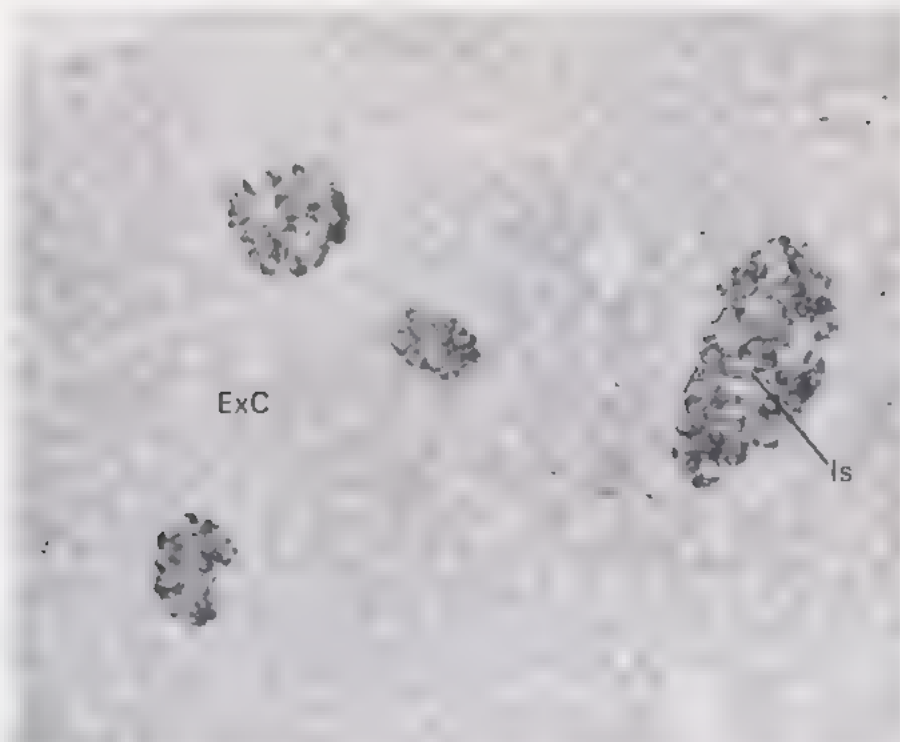


78b

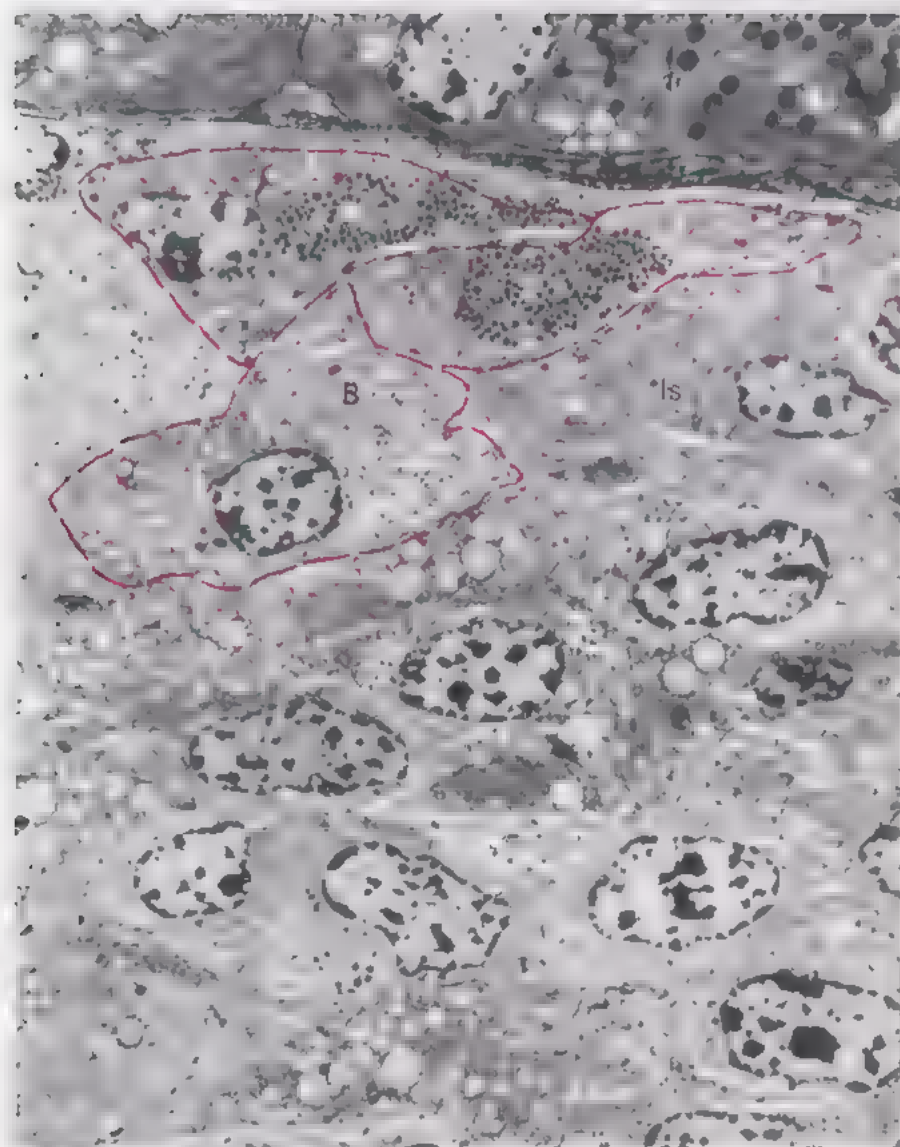


79

79 *Drosophila melanogaster* This small fruitfly (about 2.5 mm long) is widely used in developmental biology and genetics because of its ready availability and rapid, if complicated, life cycle



80

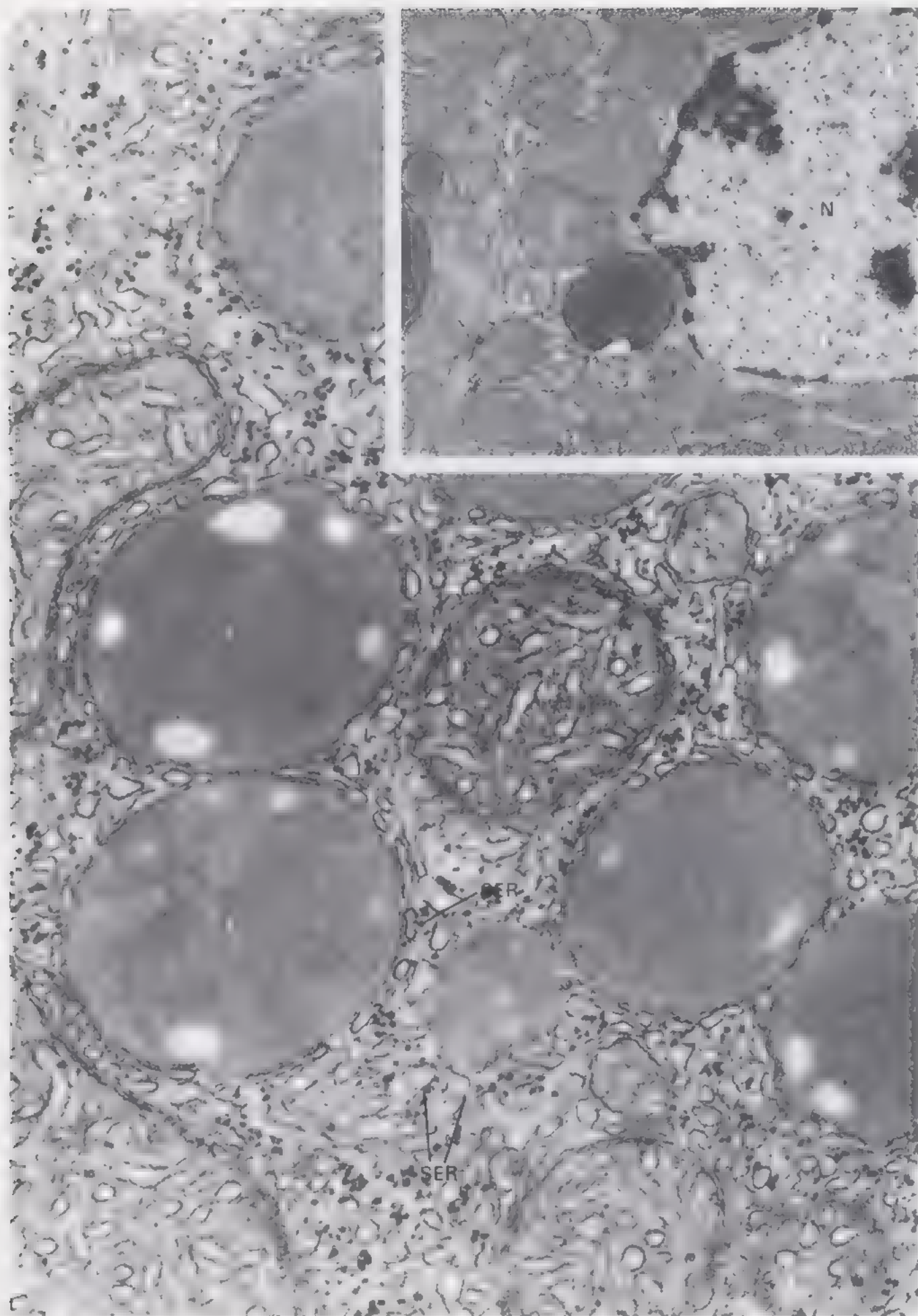


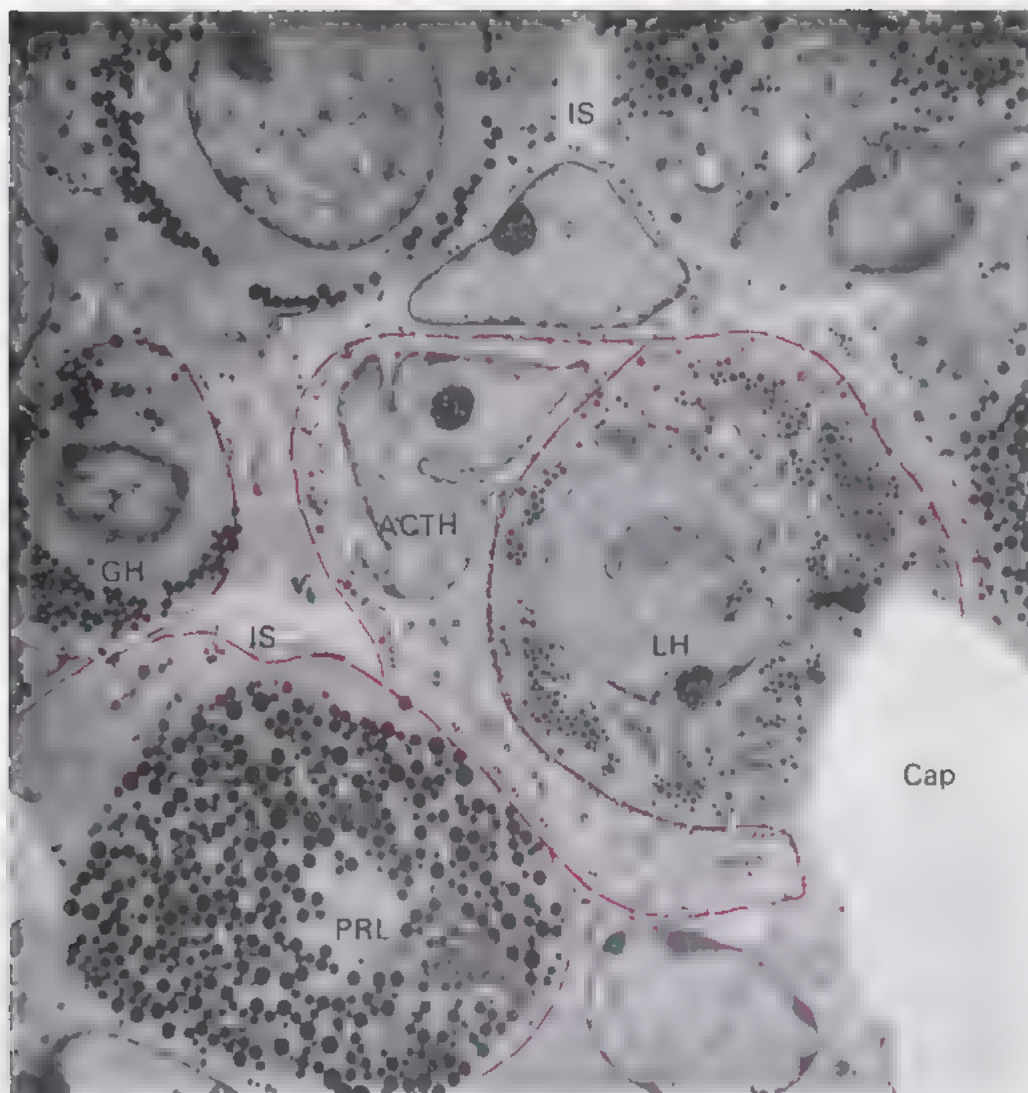
81

**80** Light micrograph of the human pancreas. Insulin-containing cells have been labelled with anti-insulin antibodies. The antibodies have then been shown up by a histochemical technique. This reveals the islet (endocrine) regions (Is) as darkly stained areas surrounded by exocrine cells (ExC). ( $\times 65$ )

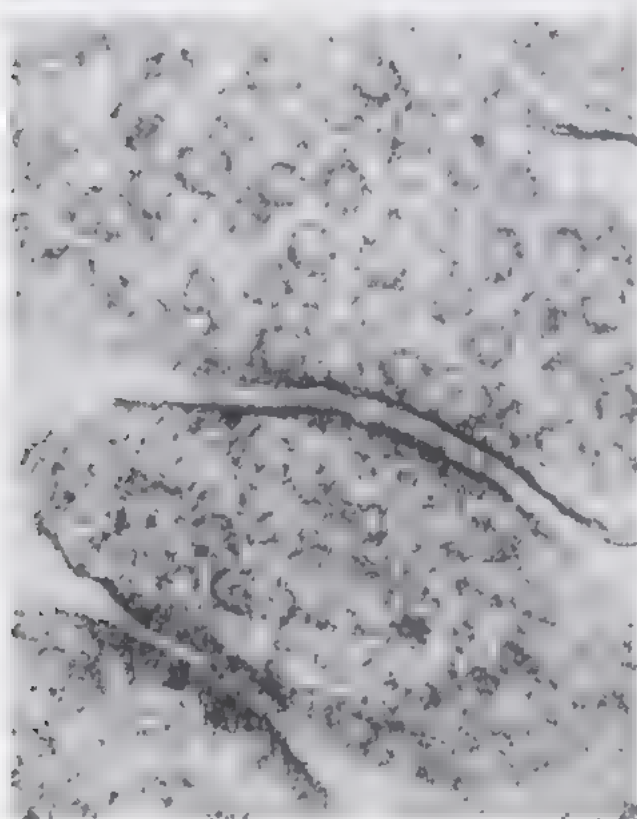
**81** Low-power electron micrograph of the human pancreas showing endocrine cells at the edge of an islet. Glucagon-secreting cells (A cells) and insulin-secreting cells (B cells) can be recognized from their distinctive ultrastructure. ExC, exocrine cells; Is, islet. ( $\times 3\,300$ )

**82** High-power electron micrograph of a steroid-secreting cell from the *zona fasciculata* region of the rat adrenal cortex. Note the lipid droplets (L) and abundant smooth endoplasmic reticulum (SER) which is often closely associated with the droplets. ( $\times 66\,000$ ) The inset is a low-power view of the cell showing the distinctive mitochondria (M). The structural appearance of these varies in the different regions of the gland but they all possess the characteristic tubular cristae. N, nucleus. ( $\times 23\,000$ )





83

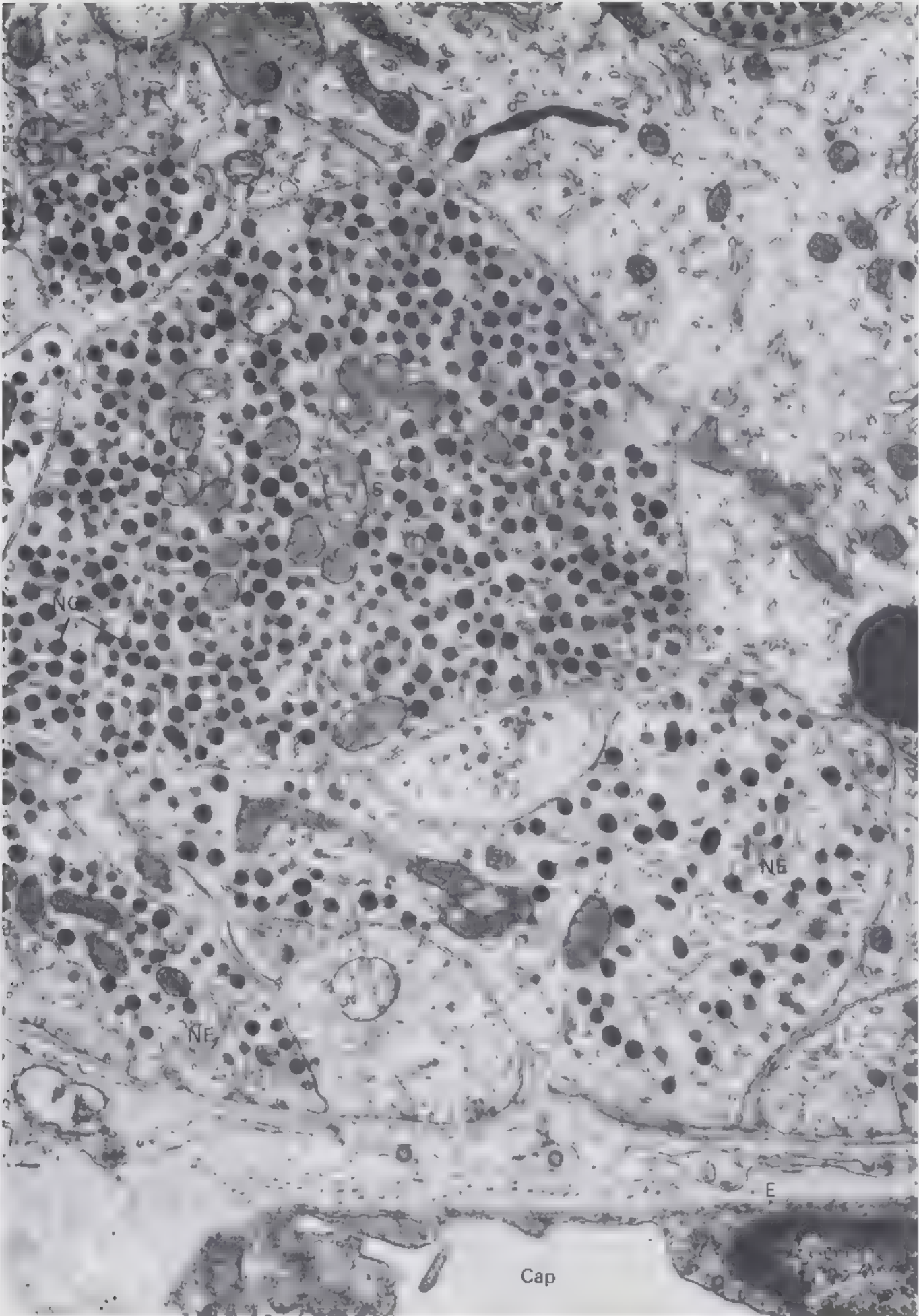


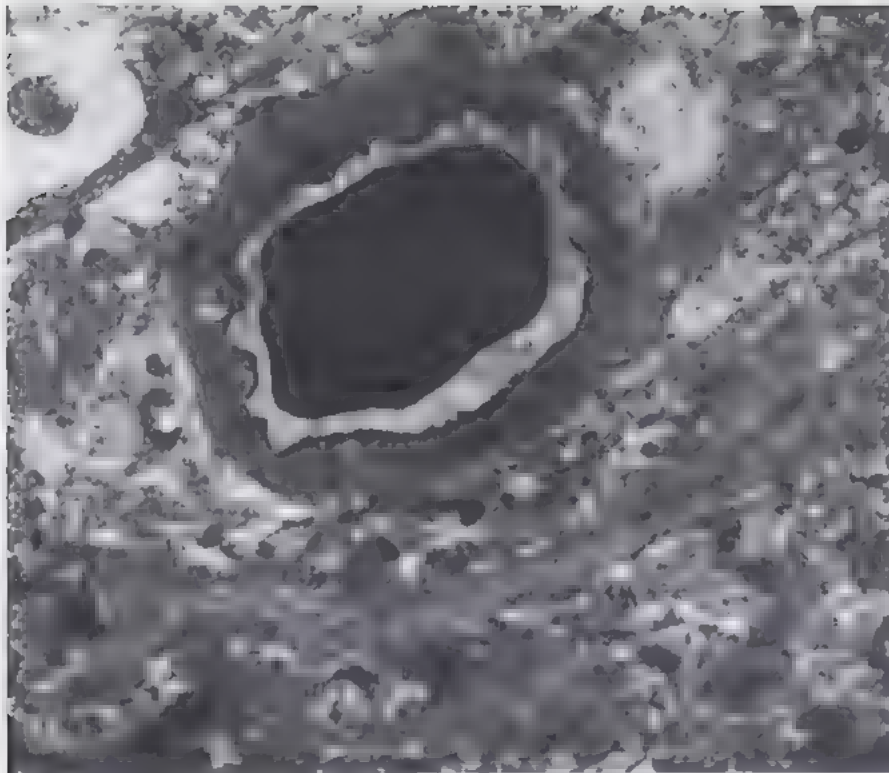
84

**83** Endocrine cells in the anterior pituitary of the laboratory mouse. Particular cell types can be identified on the basis of the size and density of the secretory granules and by using immunohistochemistry techniques. This micrograph shows secreting cells of the following types: prolactin (PRL), adrenocorticotrophic hormone (ACTH), luteinizing hormone (LH) and growth hormone (GH). The endocrine cells are either adjacent to a capillary (Cap) or an intercellular space (IS) that connects with the capillary. ( $\times 5\,400$ )

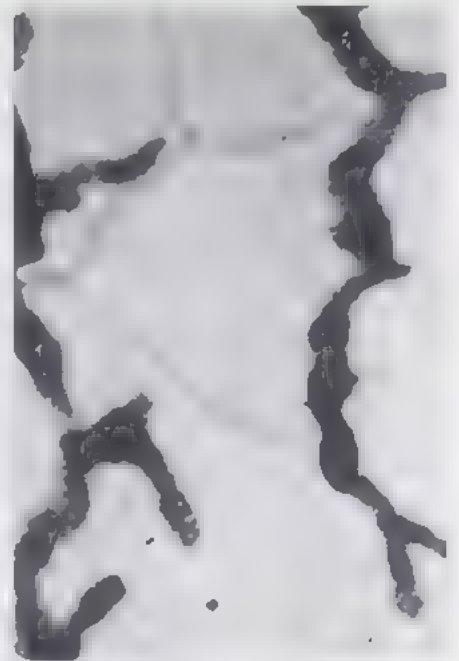
**84** The ultrastructure of a synapse. This synapse is between two neurons from the cerebellum of a young rat. Note the density of synaptic vesicles in the presynaptic ending, the thickening of both presynaptic and postsynaptic membranes and the synaptic cleft. ( $\times 160\,000$ )

**85** The neurohaemal region in the rat posterior pituitary. Neurosecretory nerve endings (NE) can be seen next to an endothelial cell (E) that forms part of a capillary (Cap). Neurosecretory axons often have swollen regions which are used as storage depots for the neurosecretion. One of these swellings (S) can be seen in the centre of the picture. Note the large number of neurosecretory granules (NG). ( $\times 10\,000$ )





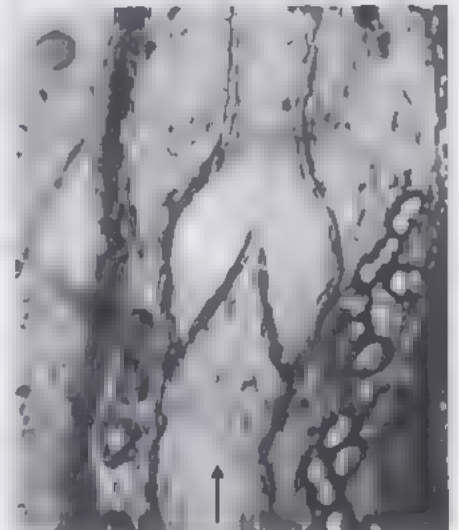
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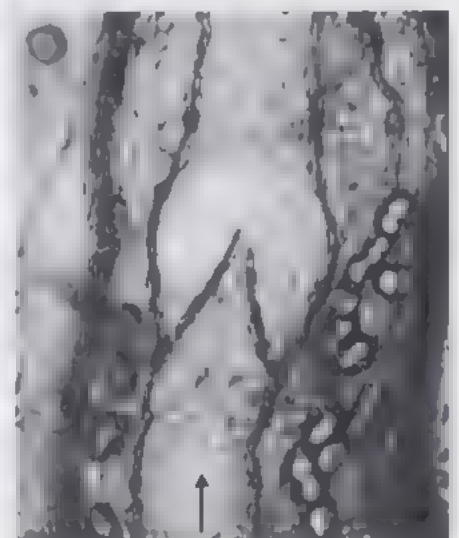
87



88



89a



89b

**86** Electron micrograph of a capillary from the brain (hippocampus) of a rat, shown in cross-section. The large dark object in the centre is a single, red blood cell. ( $\times 10\,000$ )

**87** Blood and lymph capillaries in the mesentery of a rat. The lymphatics are the large, dark vessels; the blood vessels are the very much smaller vessels. Note the blind ends of the lymphatics. The preparation was specially treated to make the lymphatics stand out—usually they are colourless and cannot be seen so well ( $\times 55$ )

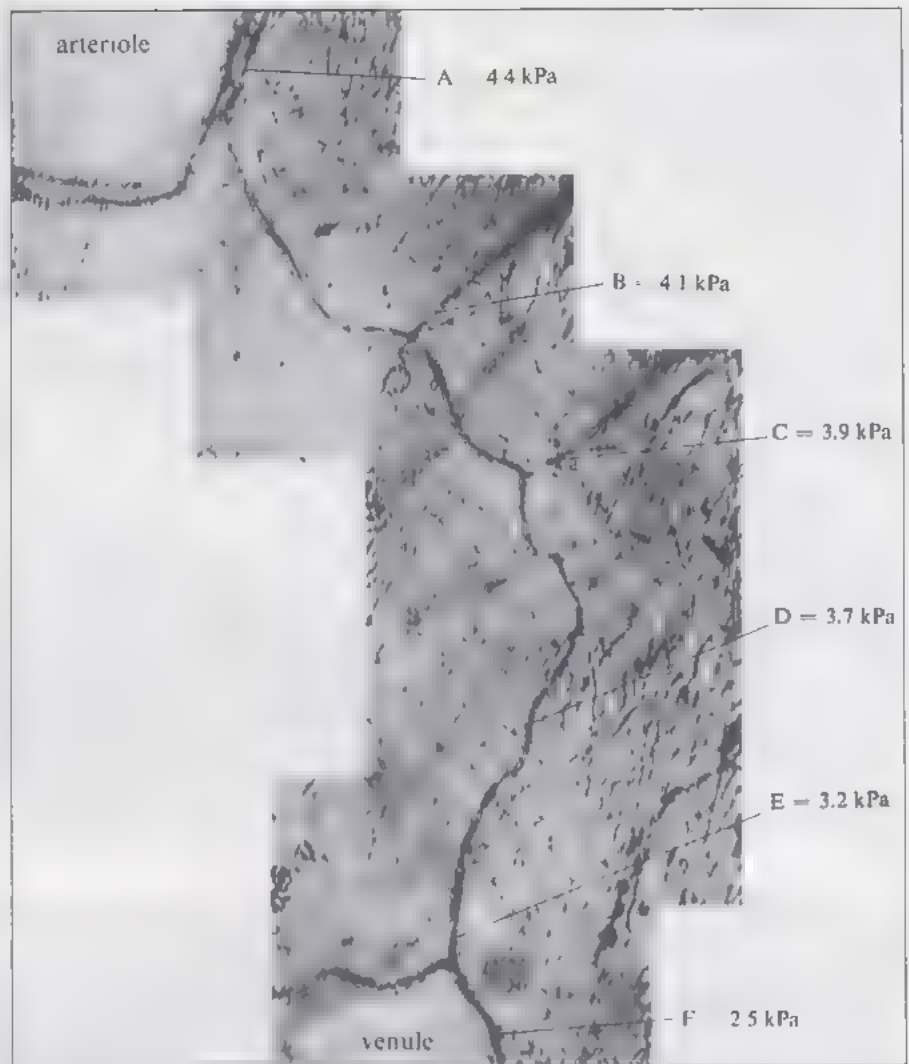
**88** Photomicrograph of rat muscle. Carbon has been injected intravenously to show up the vascular pattern. The main arteries and veins can be seen running parallel to one another (veins are the larger vessels). Note the artery–artery shunt (red dashed line), vein–vein shunt (blue dashed line), and also that this is a very different type of capillary bed from that found in the mesentery. ( $\times 15$  approx.)

**89** Valves of a lymphatic vessel. (a) Partial contraction of a collecting lymphatic in rat mesentery. (b) 3 seconds later the vessel is in a relaxed state. Note the capillary alongside. ( $\times 160$ )

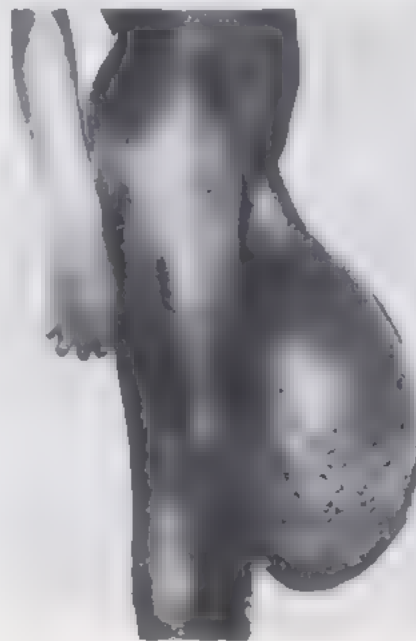
**90** A photographic reconstruction of a capillary from arteriole to venule in the cat mesentery. Direct recordings of the mean blood pressure (expressed as kPa) were taken at points A–F. The capillaries range from 7.5 to 9  $\mu\text{m}$  in diameter.

**91** Interstitial volume can increase to a gross extent when lymphatic drainage is prevented. In this case, lymphatics from the scrotum are blocked by millions of parasites—filarial worms—and the condition, for obvious reasons, is known as elephantiasis.

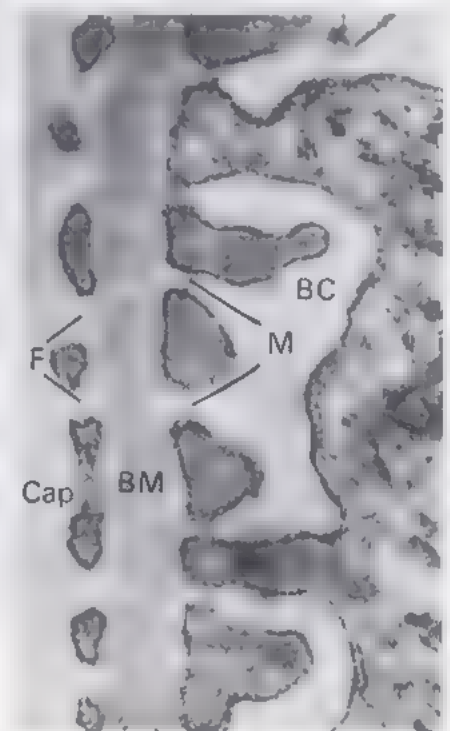
**92** The membrane between the blood and the cavity of Bowman's capsule. The lumen of the capillary (Cap) lies to the left; the cavity of Bowman's capsule (BC) lies to the right. The endothelium has numerous fenestrations (F). The slit-pores between the foot processes are closed by a thin membrane (M). The principal structure separating blood from glomerular filtrate is the basement membrane (BM).



90



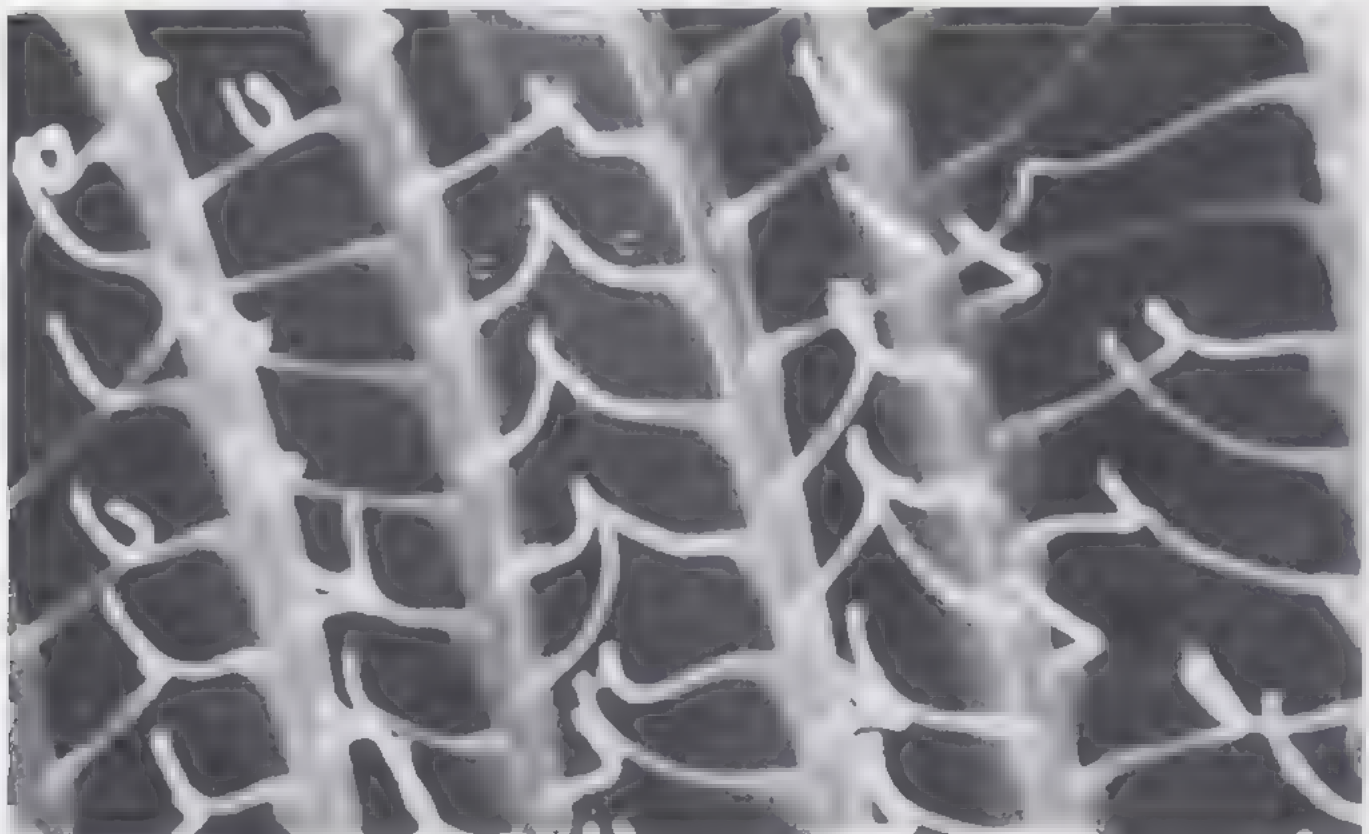
91



92



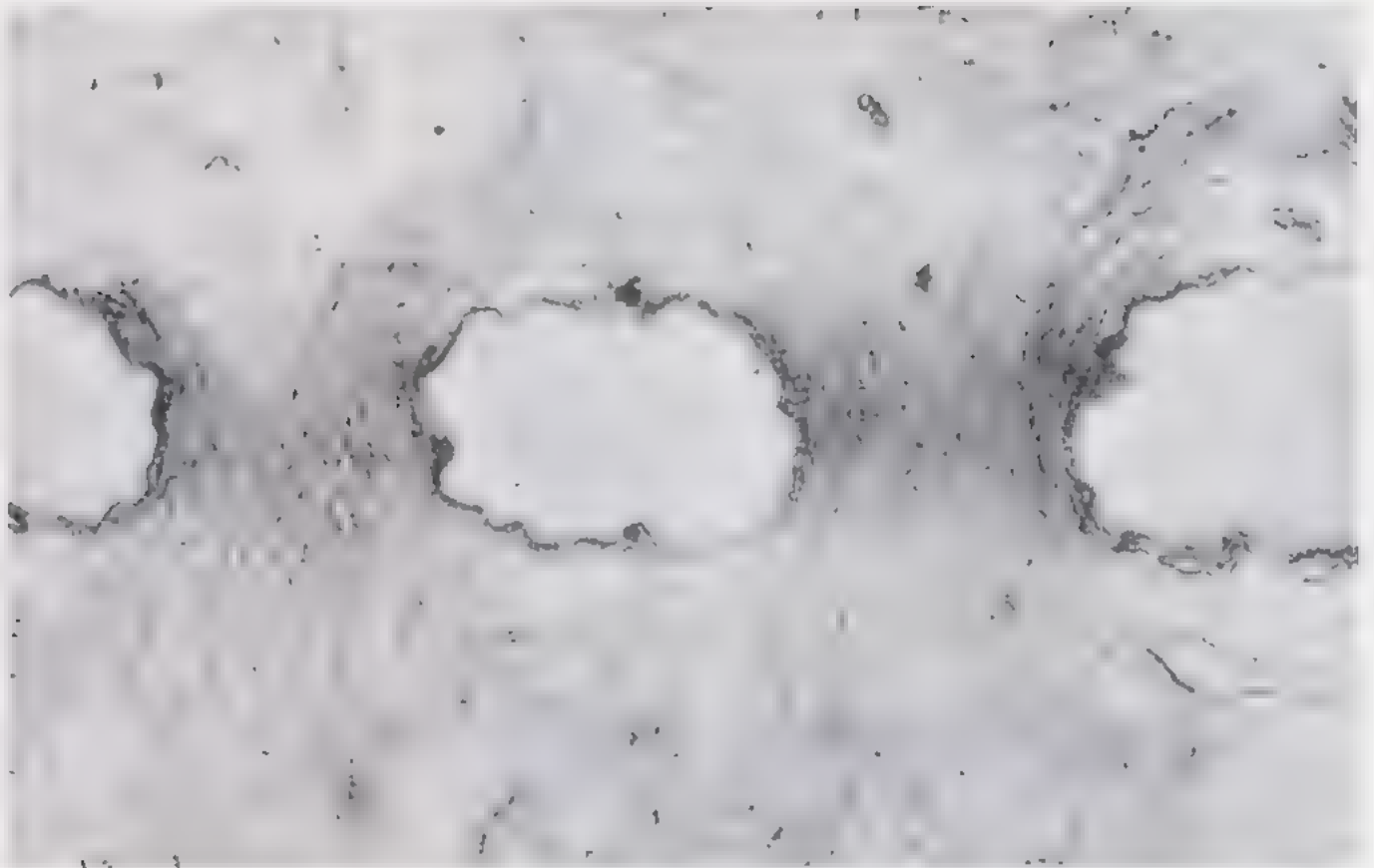
93a



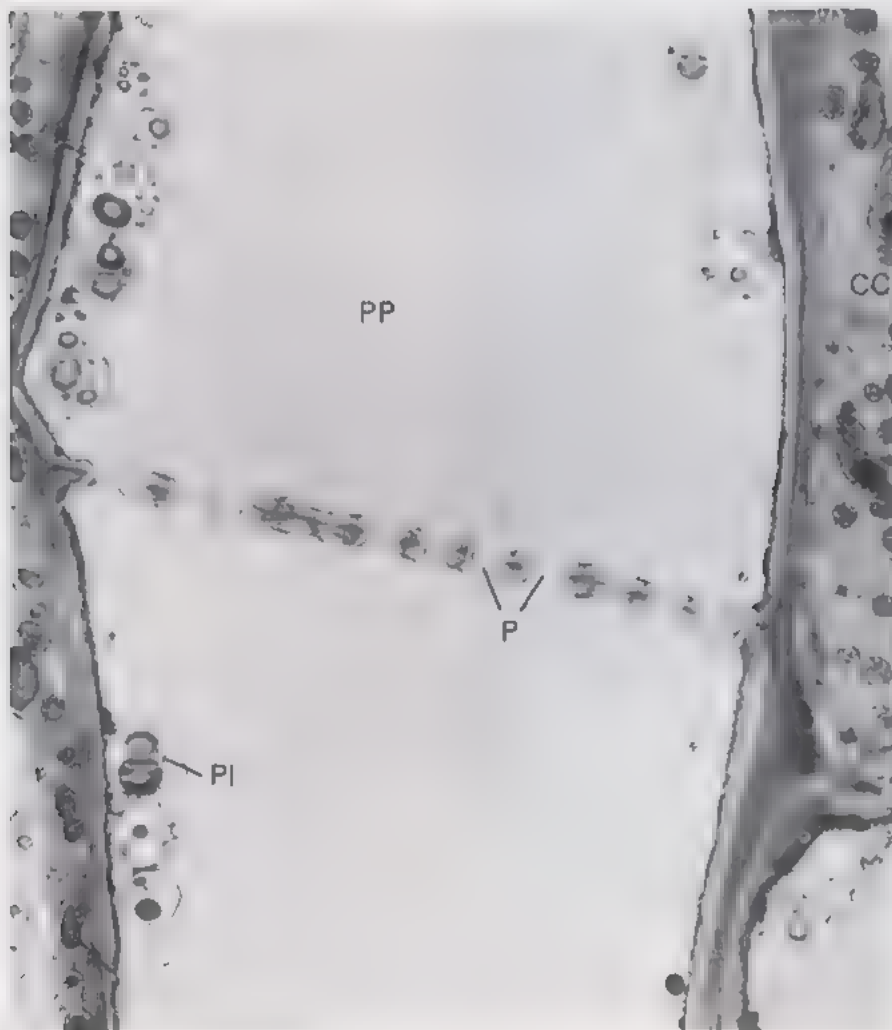
93b

93 (a) Scanning electron micrograph of three gill filaments (F) of *Mytilus edulis* showing the frontal cilia (C). Note that the latero-frontal cirri (LFC) extend across the interfilamentary spaces to form a fine-mesh filter. ( $\times 1\,100$ )

(b) High-power view of the latero-frontal cirri in (a). Each latero-frontal cirrus consists of a double row of 20-25 pairs of cilia (C), one of each pair being on either side of the main axis of the cirrus. The effect is to form a mesh-work between the cirri and also between adjacent filaments. ( $\times 8\,000$ )



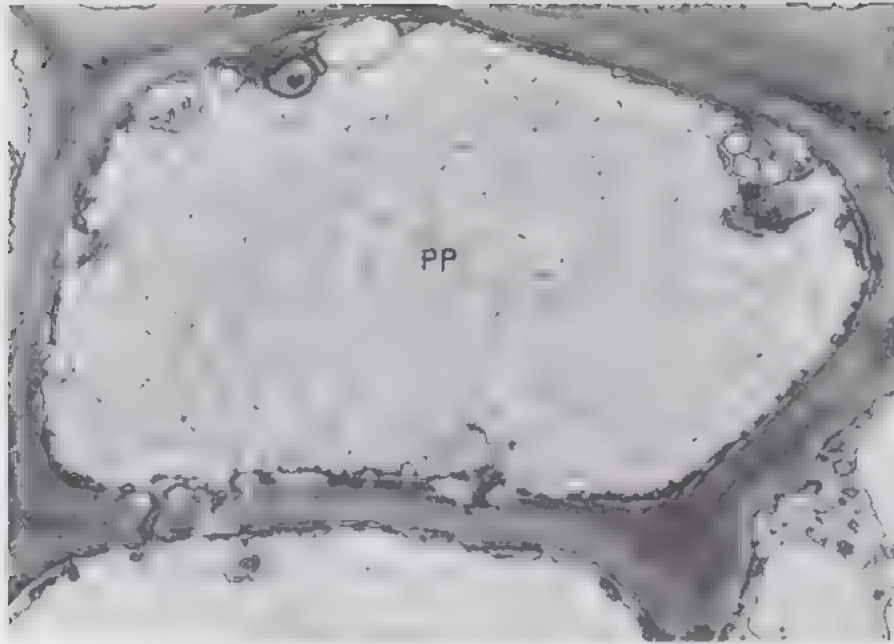
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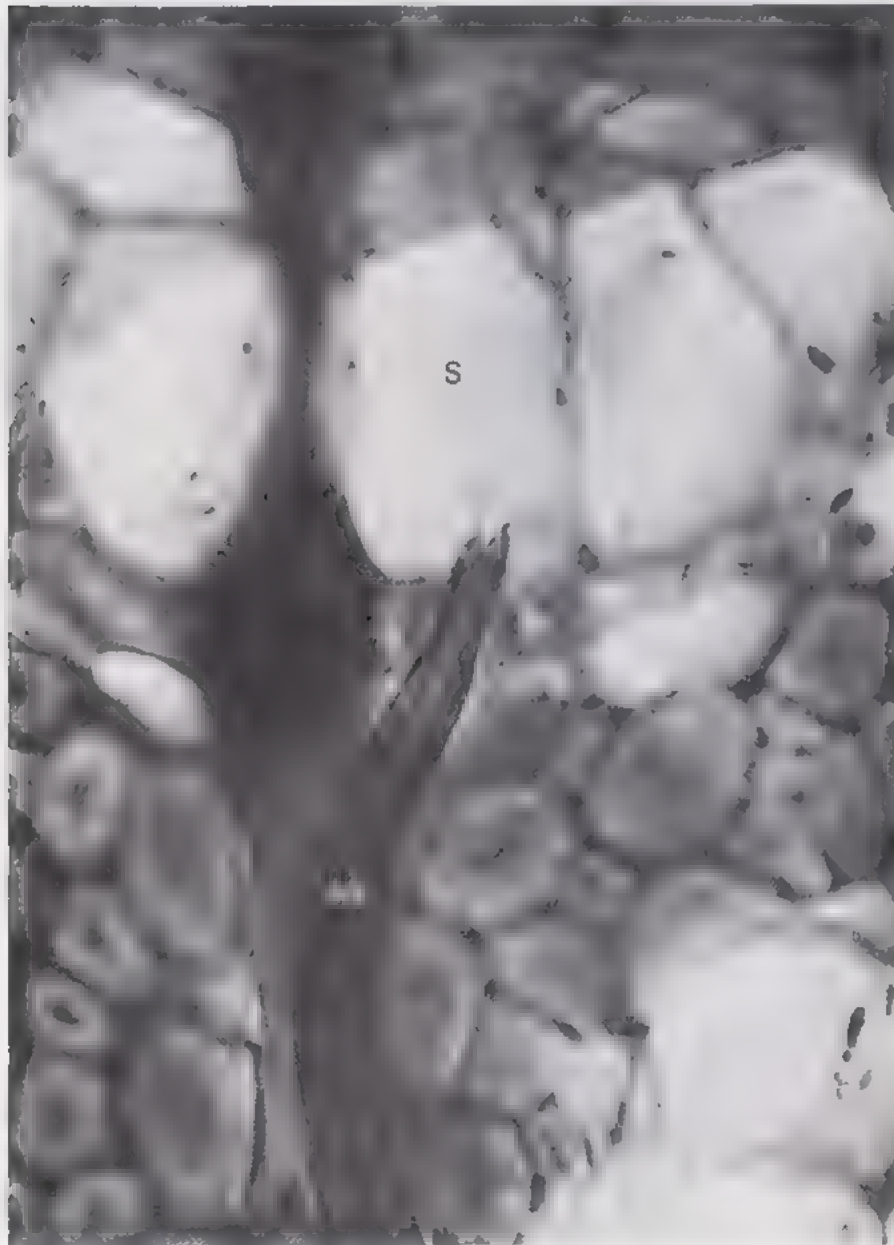
95

**94** Electron micrograph of sieve-plate pores in the phloem of *Aristolochia brasiliensis*. The pores are occluded with P-protein but relatively free from callose. ( $\times 64\,000$ )

**95** Electron micrograph showing a sieve tube and sieve plate from *Nicotiana tabacum* (tobacco) in longitudinal section. The sieve-plate pores appear open. P, sieve-plate pore; CC, companion cell; Pl, plastid; PP, P-protein. ( $\times 5\,000$ )



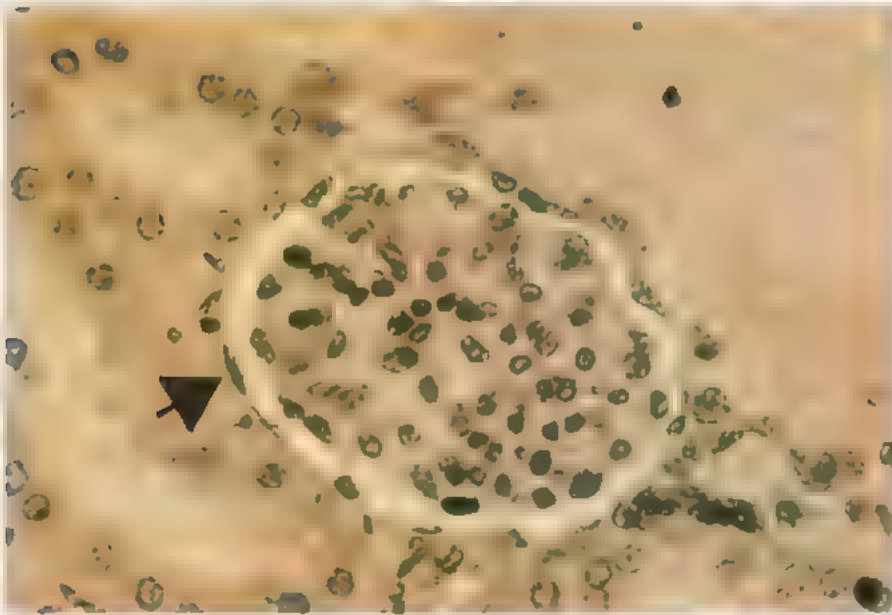
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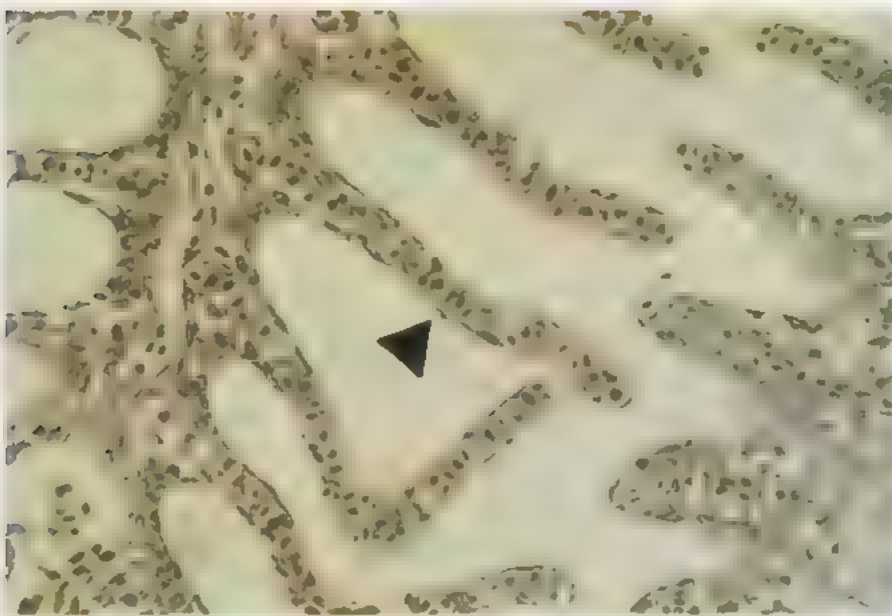
97

96 Electron micrograph of a sieve tube of *Nicotiana* in transverse section, PP, P-protein. ( $\times 1\ 800$ )

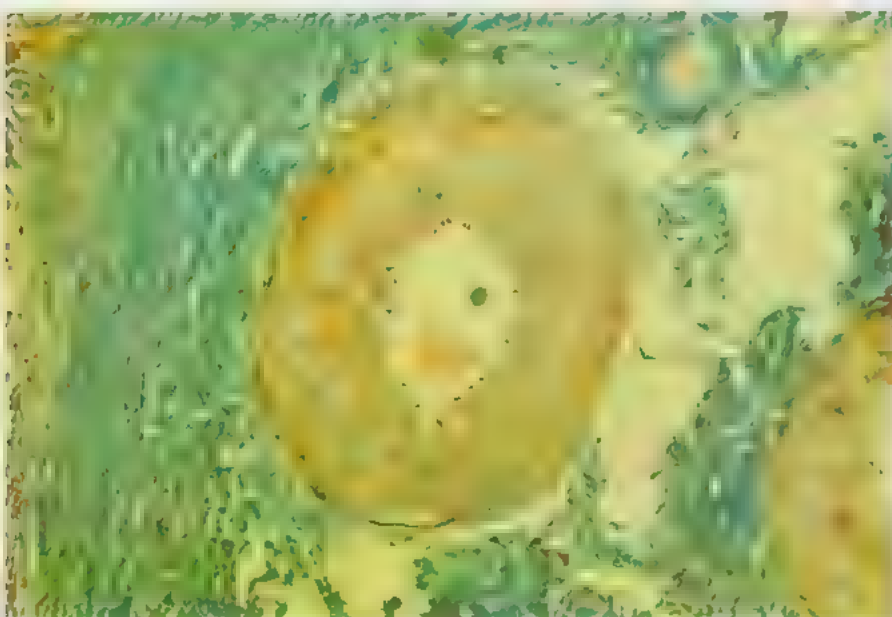
97 Transverse section of the stem of *Tilia* (lime) showing the penetration of an aphid stylet (AS) into a single sieve-tube element (S). ( $\times 800$ )



98



99

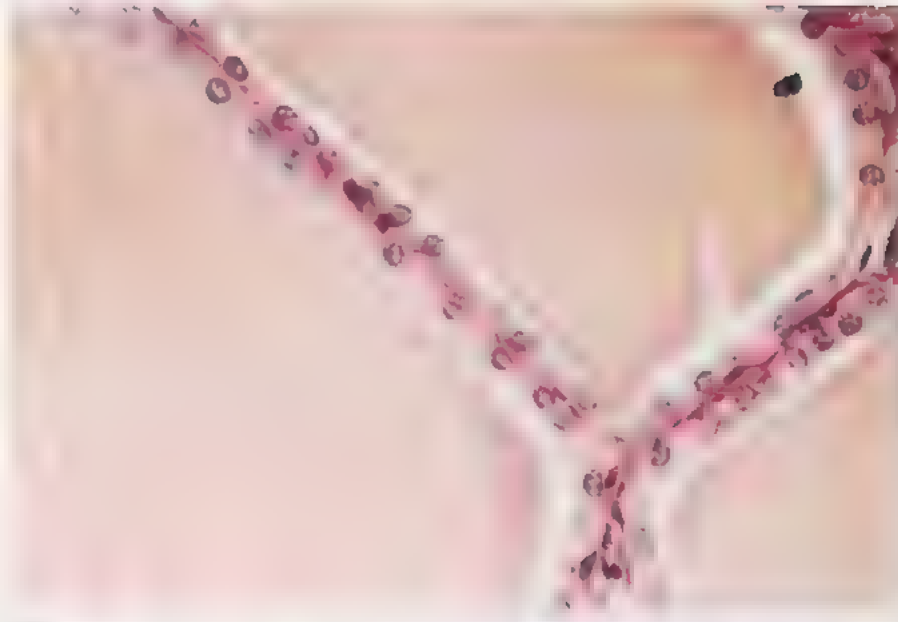


100

**98** Mammalian kidney showing glomerulus surrounded by the glomerular capsule (*arrowed*). The capsule is made up of squamous epithelium. ( $\times 300$ )

**99** Squamous epithelium (*arrowed*) lining secondary lamellae of the gills of a teleost fish. ( $\times 400$ )

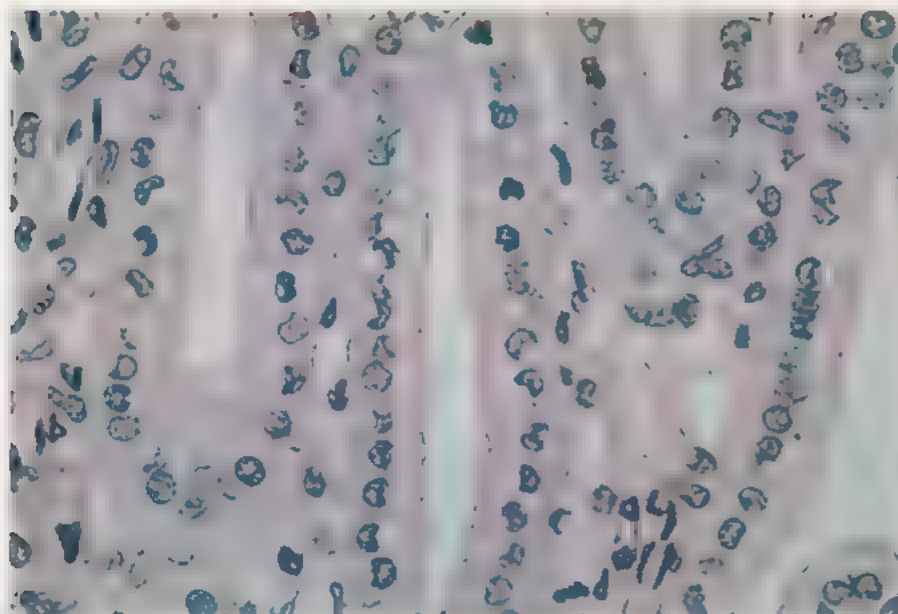
**100** Endothelium lining the lumen of an artery. ( $\times 125$ )



101



102

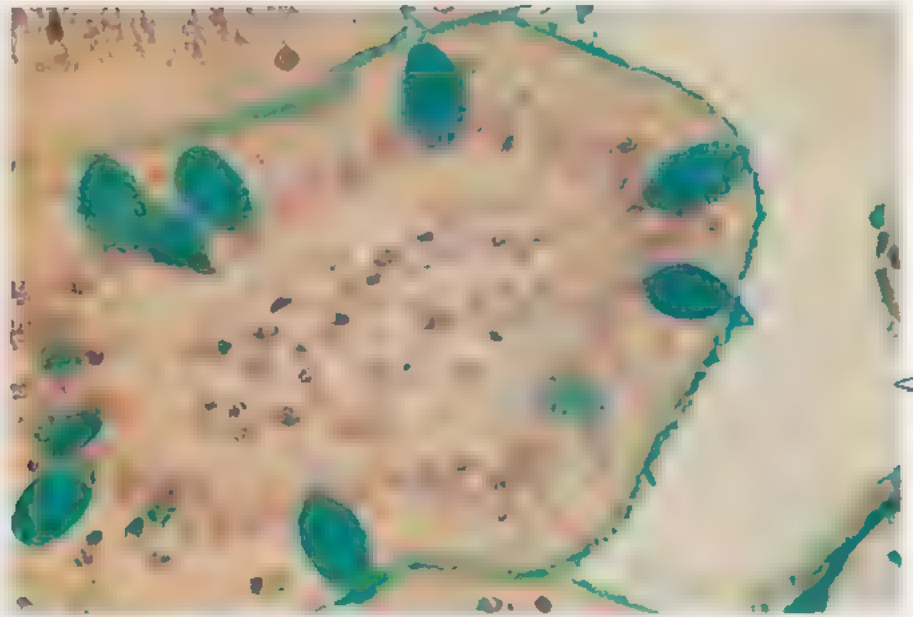


103

**101** Cuboidal epithelium lining the wall of a thyroid gland follicle. (  $\times 400$  )

**102** Cuboidal epithelium is also found in the submucosa of the small intestine where it forms Brunner's glands. (  $\times 400$  )

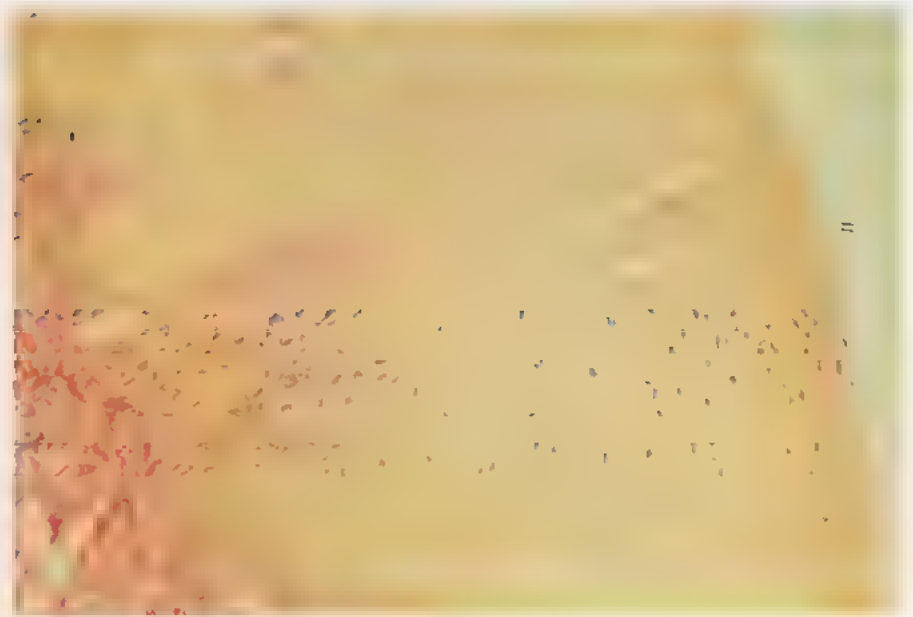
**103** Cuboidal epithelium from kidney collecting-tubules. (  $\times 600$  )



104



105

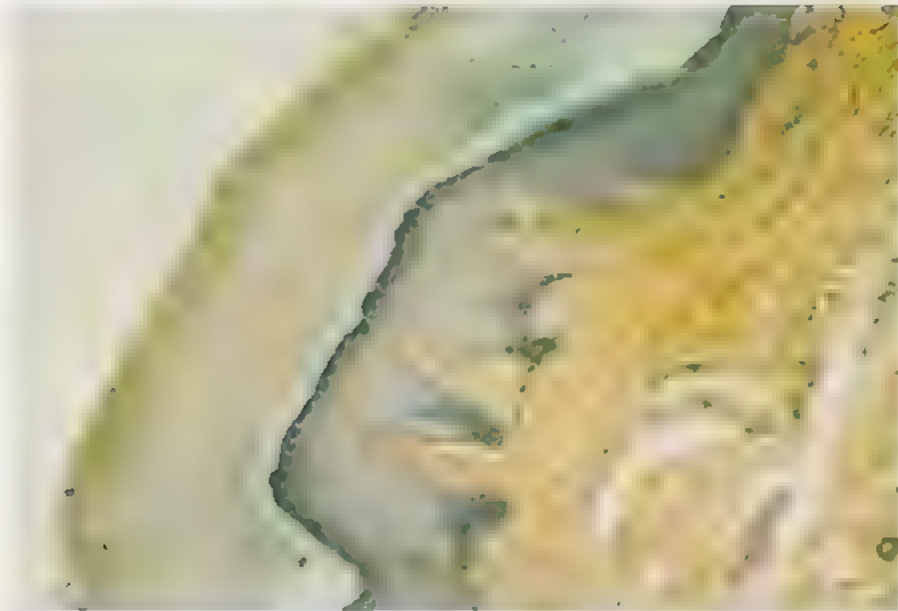


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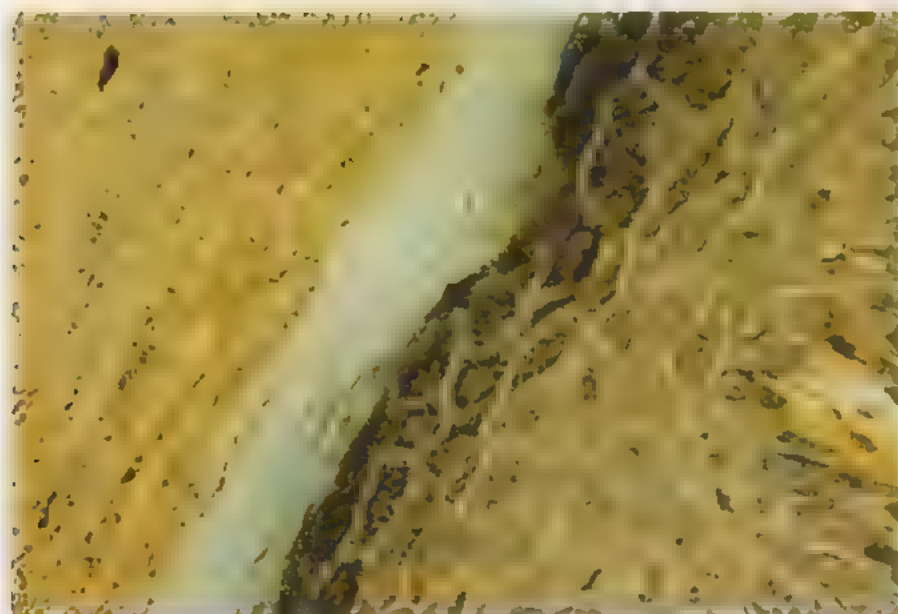
**104** Columnar epithelium on a villus from the small intestine of a rat. A histochemical reaction has stained mucus-producing cells a greenish colour. ( $\times 600$ )

**105** Ciliated, columnar epithelium lining the trachea of a mammal, the epithelium has a pseudo-stratified appearance. ( $\times 400$ )

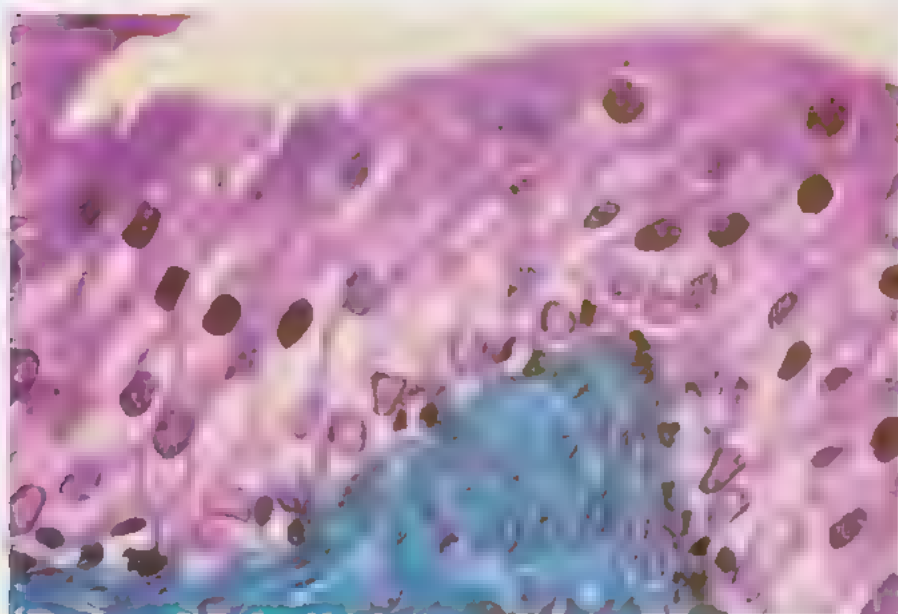
**106** Lightly keratinized epithelium. ( $\times 400$ )



107a



107b

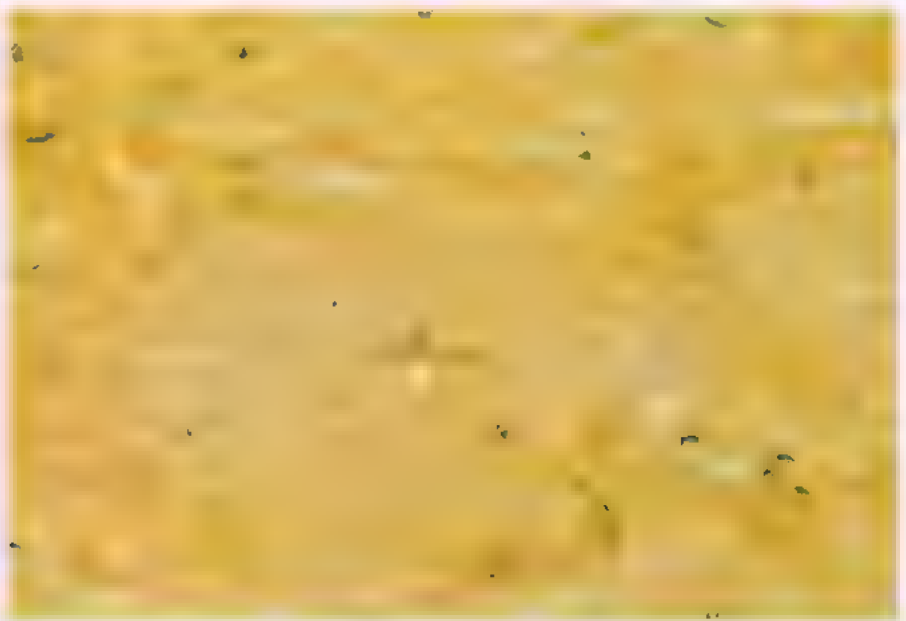


108

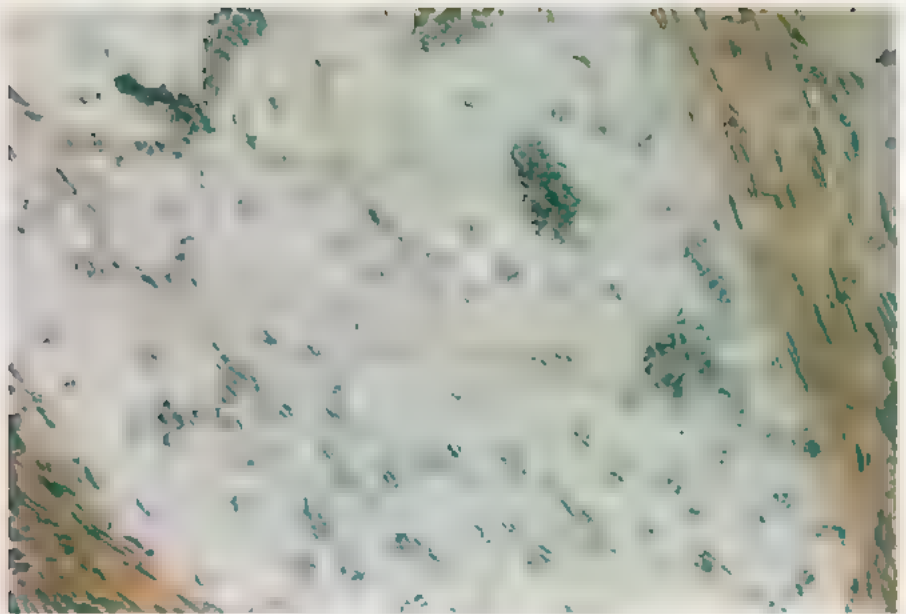
**107** (a) Low-power view of heavily keratinized epithelium from the palm of the hand ( $\times 160$ )

(b) High-power view of the central area of (a). ( $\times 400$ )

**108** Transitional epithelium lining the inside wall of bladder. ( $\times 400$ )



109



110a



110b

**109** Dense connective tissue of the type encountered in the supporting tissues of the skin. ( $\times 400$ )

**110 (a)** Low-power view of loose connective tissue from the bladder of a frog. ( $\times 200$ )

**(b)** High-power view of the central area of (a) ( $\times 500$ )



111



112



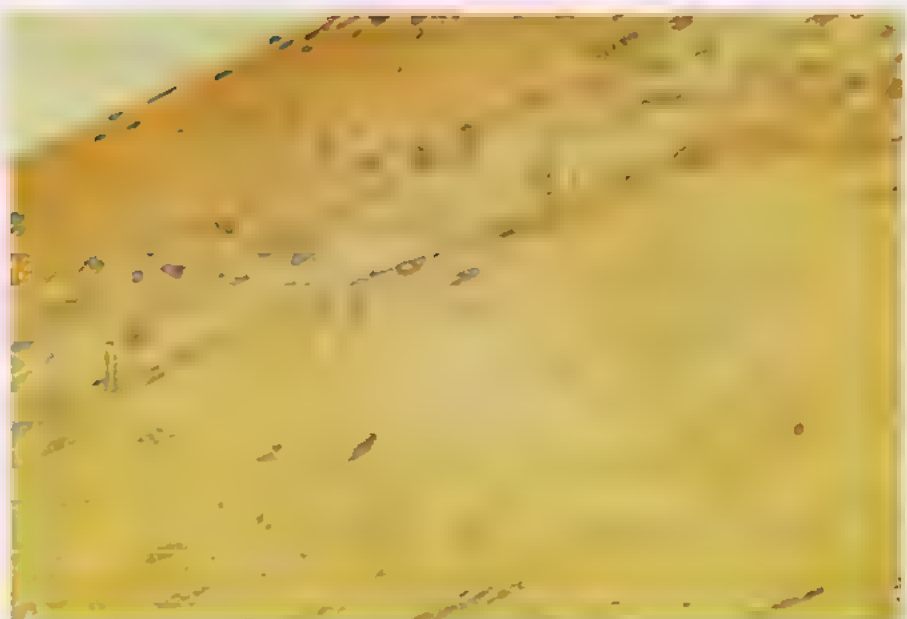
113

**111** Hyaline cartilage from mammalian trachea. ( $\times 80$ )

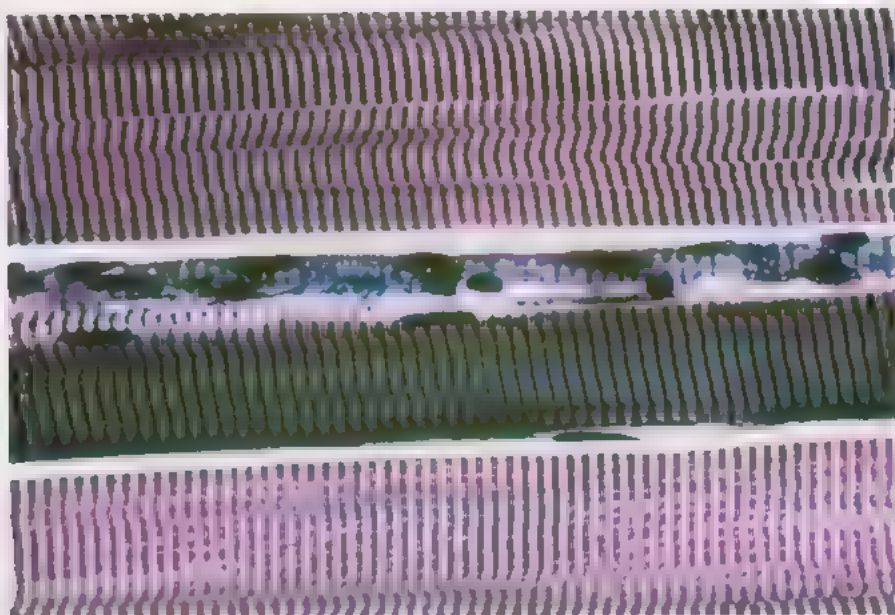
**112** A transverse section of compact bone. ( $\times 170$ )

**113** Mammalian smooth muscle in LS. ( $\times 500$ )

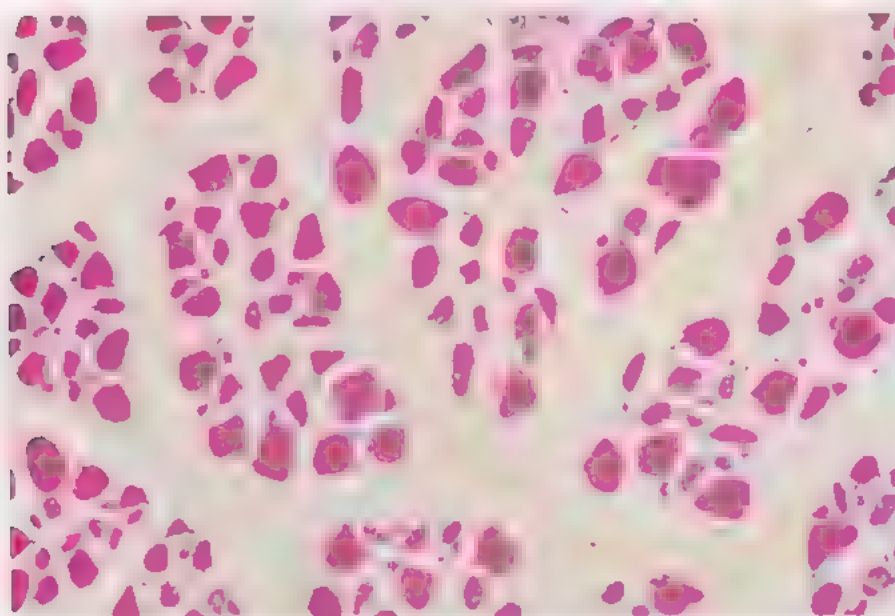
**114** Three arrangements of tissue from a mammal. At the top is smooth muscle in TS; beneath this is an area containing a large parasympathetic nerve cell; at the bottom is smooth muscle in LS. ( $\times 500$ )



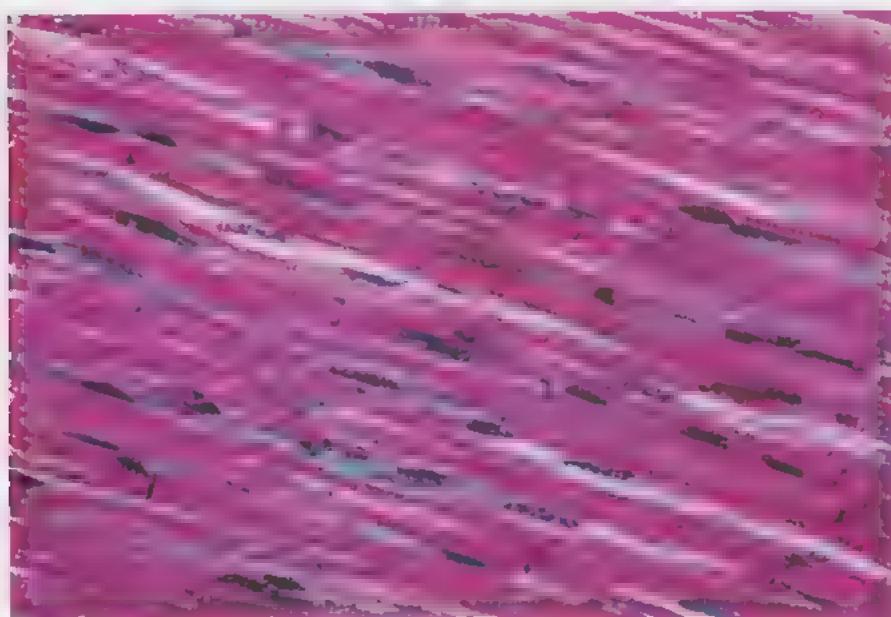
114



115a



115b

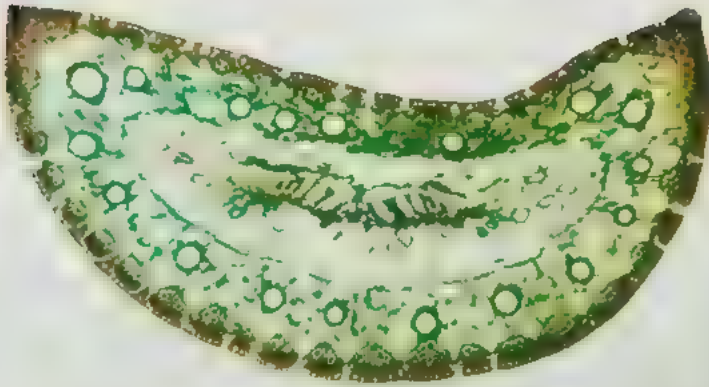


116

**115** (a) Skeletal muscle fibres in LS. ( $\times 750$ )

(b) Skeletal muscle fibres in TS. Note the peripheral location of the nuclei. ( $\times 350$ )

**116** Cardiac muscle in LS. Note the branching nature of the fibres. ( $\times 450$ )



117



118

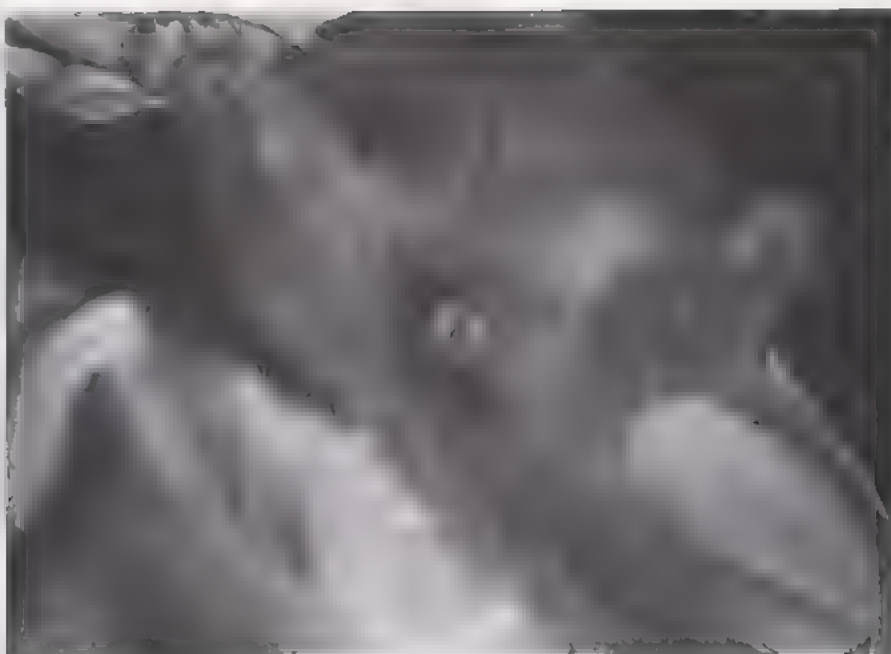


119

117 A leaf of *Pinus* (Scots pine), a xerophyte, in TS

118 A leaf of *Prunus* (cherry), a mesophyte, in TS.

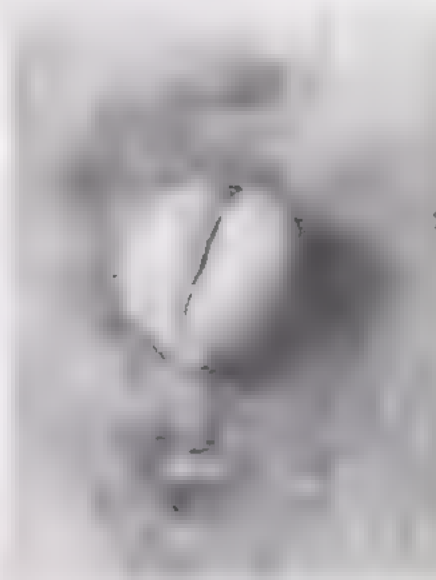
119 A leaf of *Nymphaea* (waterlily), a hydrophyte, in TS.



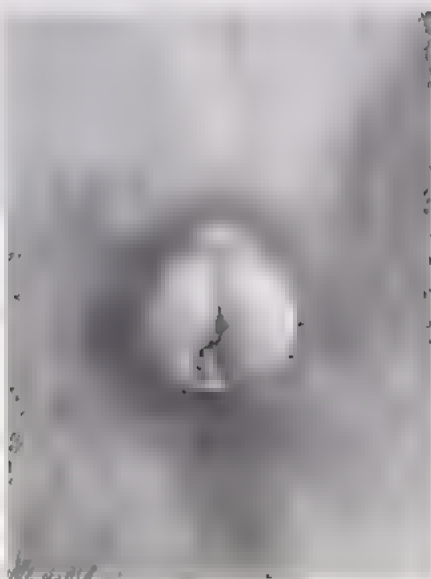
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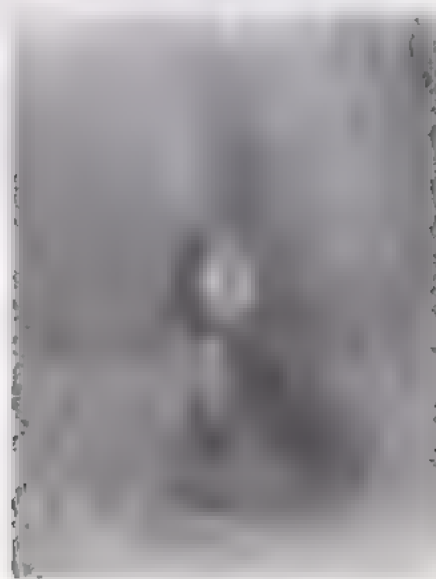
120a



120b

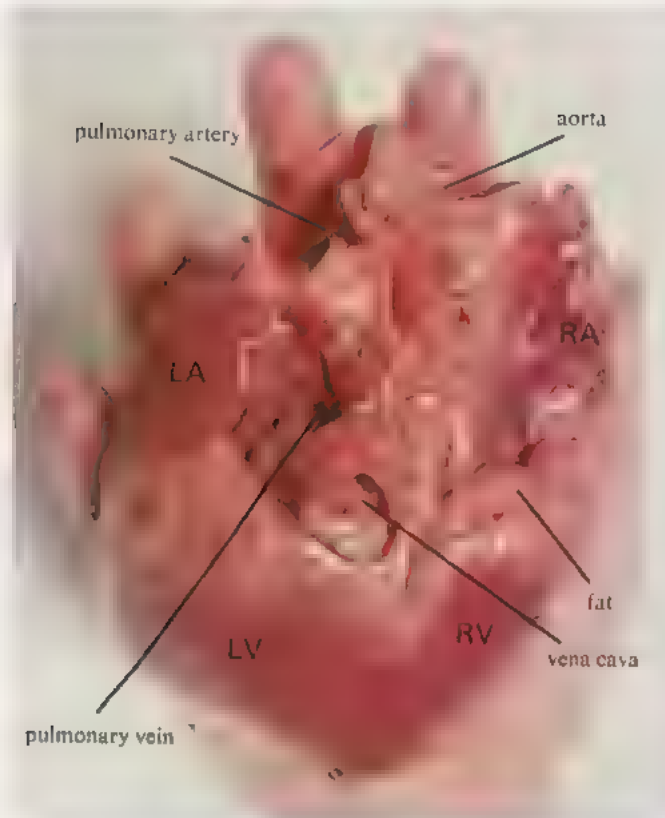


120c



120d

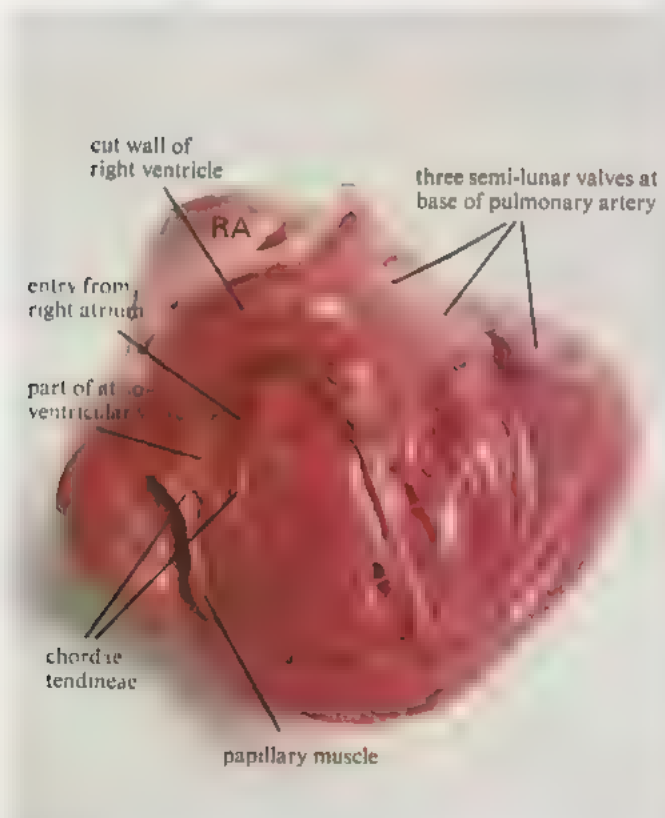
**120** Photographs of the external genitalia of mature female ferrets. The top photograph shows the position in which the four lower photographs were taken. (a)–(d) are four groups of ferrets kept under different conditions



121

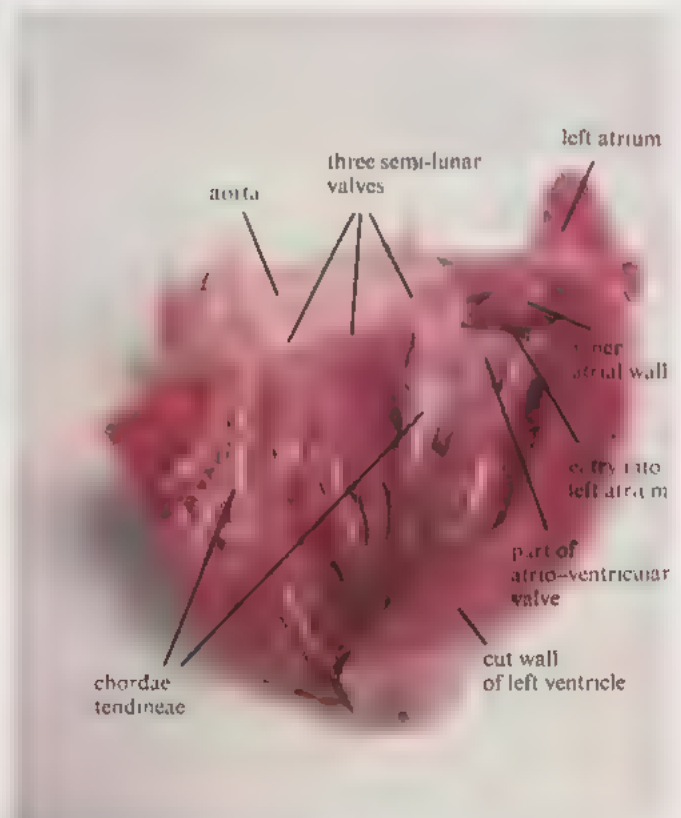


122



123

**121** Dorsal view of the heart of a pig. The diameter of the pulmonary arterial wall appears larger than usual, partly as a result of the angle of the heart and partly because the pulmonary artery had been slashed. The ventricles are foreshortened because of the angle at which the picture was taken. LA, left atrium; RA, right atrium; LV, left ventricle; RV, right ventricle.

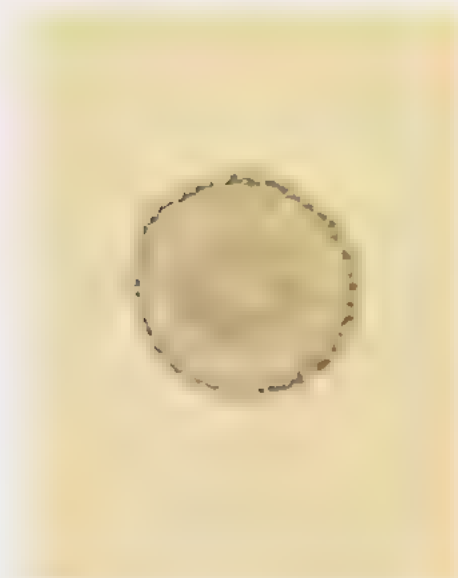


124

**122** Pig's heart, showing the result of slicing across the apex of the two ventricles

**123** The pig's heart opened to display the right ventricular cavity.

**124** The left ventricular chamber of the pig's heart



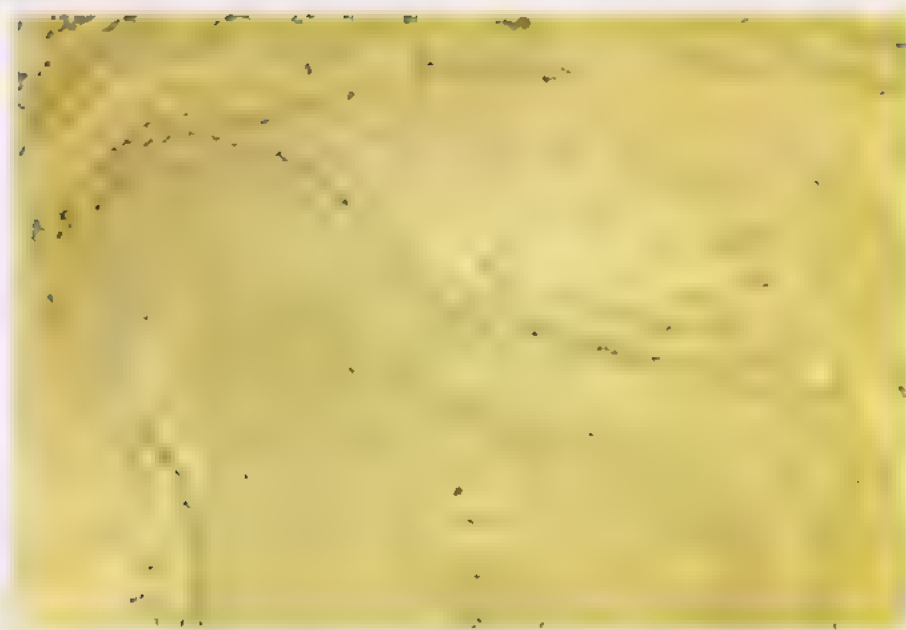
125a



125b



125c



125d

**125** Cucumber roots in TS, taken 10  $\mu\text{m}$  behind the root tip. Seedlings were germinated in (a) water, (b)  $0.1 \text{ mg l}^{-1}$  2,4-D, (c)  $1 \text{ mg l}^{-1}$  2,4-D, and (d)  $10 \text{ mg l}^{-1}$  2,4-D. In (d), note that only part of the whole section is shown. All photographs are at the same magnification. ( $\times 400$ )

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